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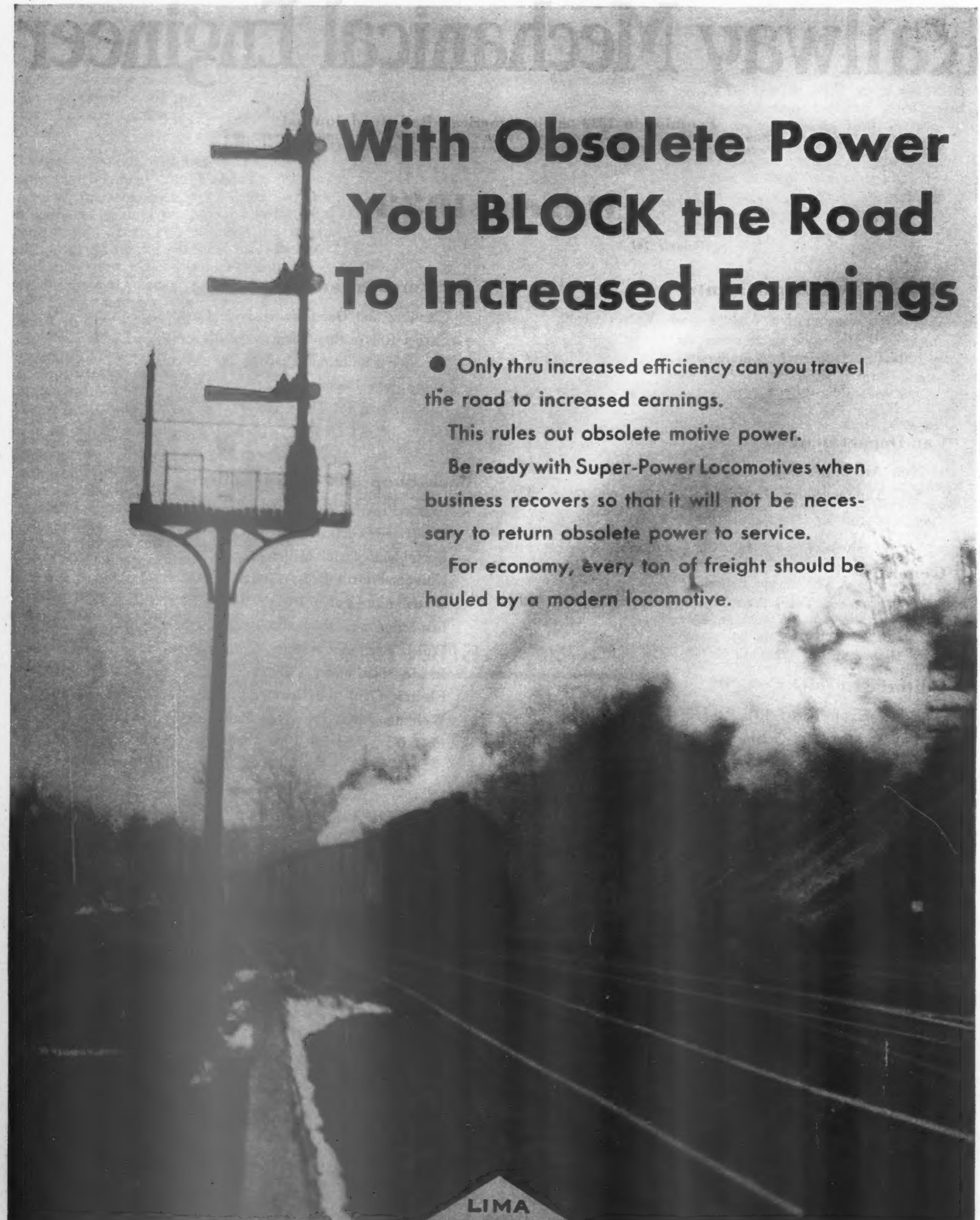

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Railway
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March - 1933

New Air Brake Equipment For Freight Train Cars

Designed—after exhaustive laboratory and road tests—to meet exacting modern operating and maintenance conditions

THE new Westinghouse "AB" brake equipment, which makes possible the safe, expeditious and efficient handling of freight trains up to 150 cars in length, has been applied to 925 Pennsylvania Railroad box cars. A series of demonstrations will shortly be conducted under the auspices of the Mechanical Division of the American Railway Association. The new brake equipment will interchange with the type "K" equipment and has been so designed as to insure low inspection and maintenance costs.

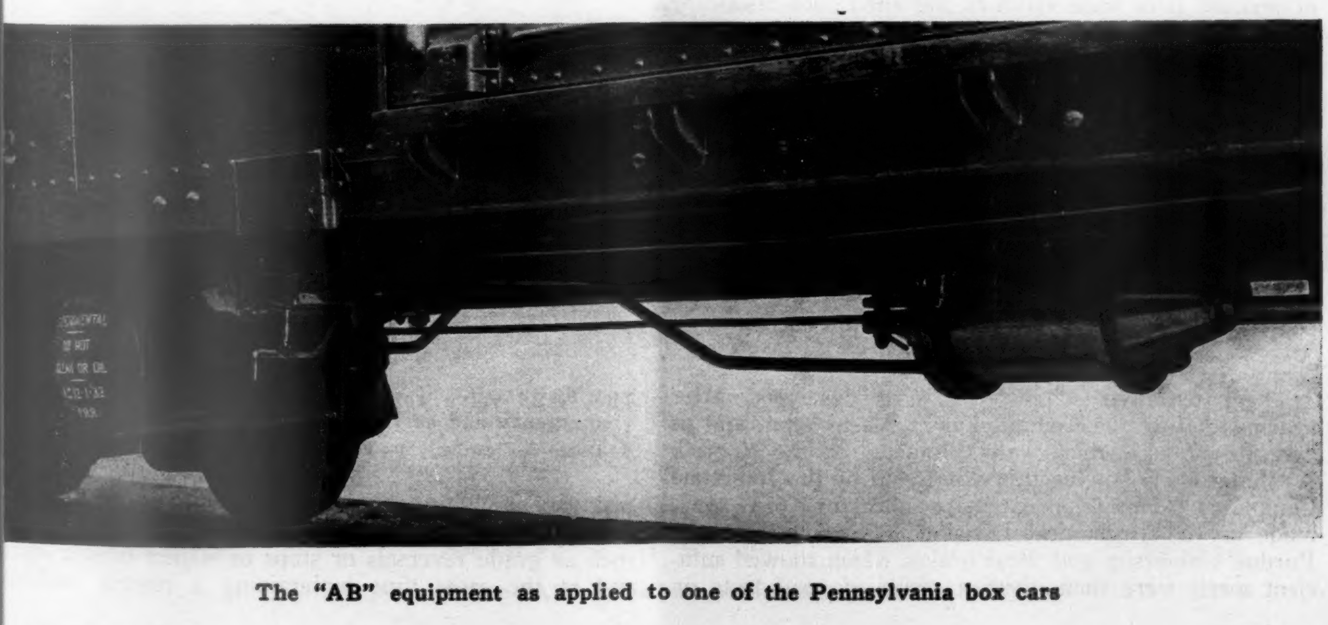
The type "K" triple valve equipment, now in general use, was first applied to freight cars in 1905, and marked a long step in advance over the original quick action triple valve, which was developed as a result of the famous Burlington tests in 1888. A remarkable improvement in freight-train operation has taken place since the "K" triple was introduced, as is clearly indicated by the table on freight train statistics.

It will be recalled that in 1923 the American Railway Association started an aggressive campaign to improve the efficiency and effectiveness of freight movement, the favorable results of which are evident from the last

Freight Train Statistics

	1905	1922	1929
Tons per loaded car	18.1	26.9	26.9
Cars per train	26.1	38.4	48.6
Net tons per train	322.3	676.0	804.0
Freight train speed (miles per hour between terminals)	...	11.1	13.2
Gross ton-miles per freight-train hour	...	16,188	24,539
Net ton-miles per freight-train hour	...	7,479	10,580

three items in the above table. In July, 1924, the Interstate Commerce Commission made certain tentative suggestions as to improvements which seemed desirable in



The "AB" equipment as applied to one of the Pennsylvania box cars

order that the brakes might better meet the new and prospective conditions. These tentative suggestions follow:

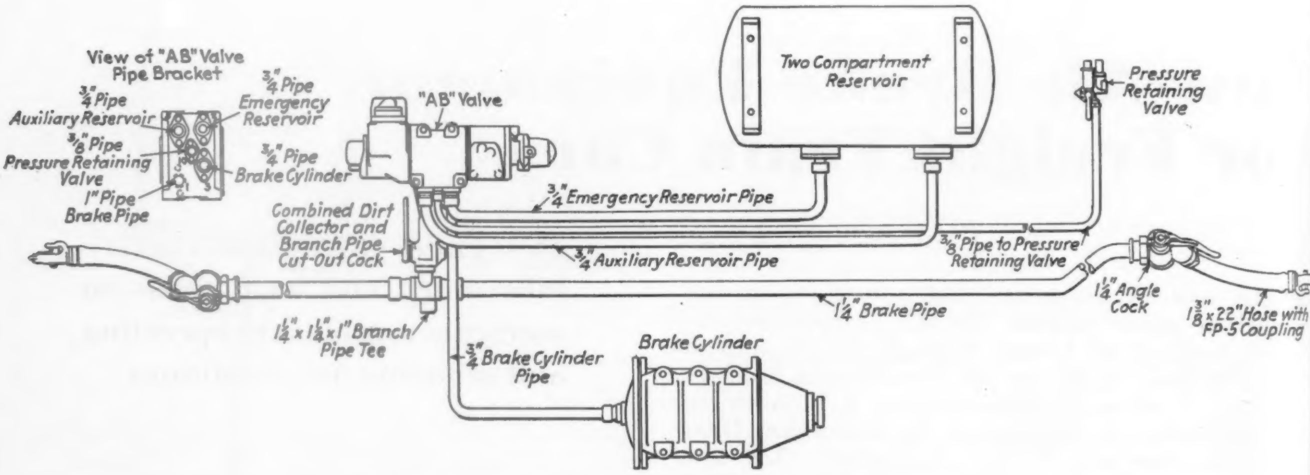
I. C. C. Tentative Suggestions

Improvements in the operation of power brakes for both passenger and freight trains are essential and must be effected.

Improvements in power-brake appliances can be made and increased safety in train operation can and must be obtained.

A power-brake system for passenger and freight trains should insure that only a service application of the train brakes will occur when a service reduction of brake-pipe pressure is made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made from a fully charged brake system.



Showing arrangement of "AB" freight brake equipment

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when emergency reduction of the brake-pipe pressure is made after a full service brake-pipe reduction has been made.

A power-brake system for passenger and freight trains should provide means whereby effective emergency brake-cylinder pressures will be obtained when an emergency reduction of brake-pipe pressure is made following release after a full service brake application.

A power-brake system for passenger and freight trains should provide means whereby the engineman can control the release of pressure from brake cylinders and effect such release by graduated steps or gradually, in order that he may decrease as well as increase brake-cylinder pressures as required to control at relatively uniform rates the speed of trains.

A power-brake system for passenger and freight trains should provide for obtaining and maintaining brake-cylinder pressures within prescribed limits for specified periods of time during brake applications.

In addition to these general requirements it is clear that full specifications and requirements covering more fully the functions, maintenance, and operation of power-brakes and appliances should be adopted. Consideration will be given to this and to the form of order to be issued by us. This case will be held open for that purpose.

The Brake Tests

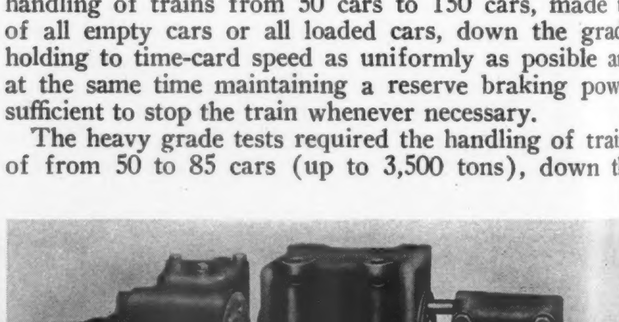
These tentative suggestions were developed after hearings before the Commission in Washington, and as a result of tests which were conducted on the Norfolk & Western. Following this expression by the Interstate Commerce Commission extensive laboratory tests were made on the Mechanical Division 100-car test rack at Purdue University and those brakes which showed sufficient merit were then given a series of road tests on the Southern Pacific on trains ranging in length from 50 to 150 cars. The road tests started August 1, 1929, and were completed April 21, 1931. The standard type "K" equipment was also tested to obtain a basis of comparison for the new equipments.

The different types of road tests to which the brakes were subjected were as follows:

Tests on a level road section were designed particularly to determine stopping distances and the action of slack during brake operations. These required the stopping of trains of 50 cars to 150 cars—with all cars loaded, all cars empty, and with mixed loaded and empty cars in the same train; from initial speeds of from 5 to 50 miles per hour; by means of service applications of varying intensities and also emergency applications. The schedule specified other tests to show the flexibility of a brake equipment.

Tests on a long moderate grade section required the handling of trains from 50 cars to 150 cars, made up of all empty cars or all loaded cars, down the grade, holding to time-card speed as uniformly as posible and at the same time maintaining a reserve braking power sufficient to stop the train whenever necessary.

The heavy grade tests required the handling of trains of from 50 to 85 cars (up to 3,500 tons), down the



The "AB" valve consists of three distinct parts—The emergency and service portions and the pipe bracket

A—Emergency portion. B—Pipe bracket, which contains quick action chamber and brake pipe strainer. C—Service portion.

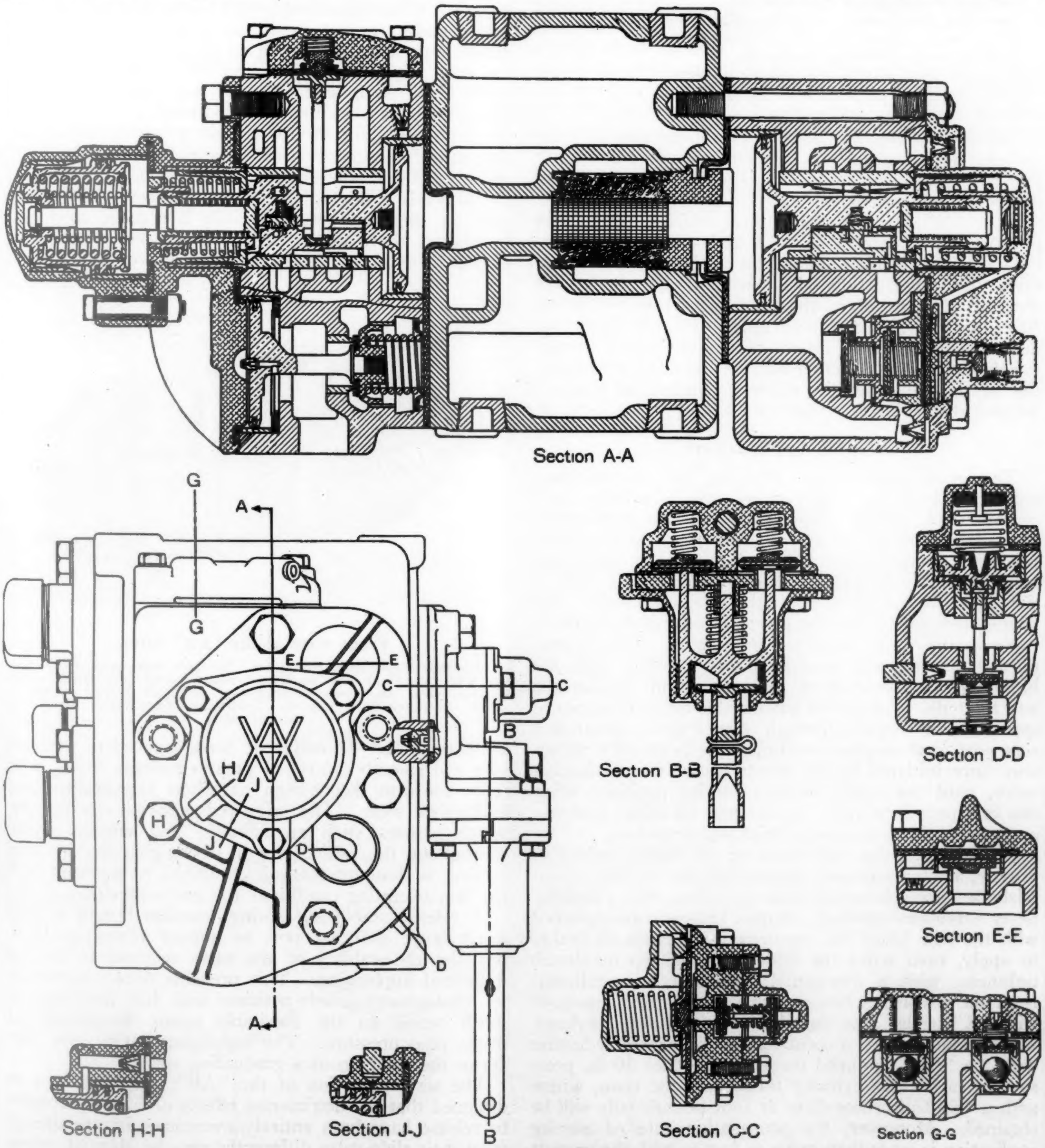
Siskiyou mountains, holding to time-card speed as uniformly as possible consistent with operating conditions such as grade reversals or stops to inspect wheels, etc. and at the same time maintaining a reserve braking

power sufficient to stop the train whenever necessary. The profile and plan view of the heavy grade test track with its numerous curves is shown in one of the illustrations. The total curvature between Ashland and Hornbrook is 8,164 deg., or over 22 complete circles. Only one locomotive and the air brakes controlled the train descending the mountains, but as many locomotives as were necessary (sometimes six of the 2-10-2 type) were used in ascending. Each test included the descent of the entire grade from Siskiyou to Hornbrook and also from Siskiyou to Ashland.

Types of Brakes Tested

The brakes given road tests included the standard type "K"; the Westinghouse FC-5, which was designed to comply with the tentative specifications of the Interstate Commerce Commission, and which included also other features not covered in the specifications; the Westinghouse FC-3 equipment, which in rack tests developed many features which appeared to make it desirable for modern freight-train operation; and Westinghouse FC-3A equipment, which included certain modifications from the Westinghouse FC-3 equipment.

No attempt was made to put the new equipments for test purposes in a commercial form. Rather, they were developed both for ease of installation on the test rack and facility in changing from one equipment to another, so as not to make it necessary to provide entirely new equipments. As a result of the investigations and tests, conducted at great expense and extending over almost a



The "AB" valve and its various parts

decade, the new type "AB" equipment was developed. It represents in a commercial form those features which were found to be most valuable in the tests.

The New Brake and Its Operation

Desirable characteristics of the Westinghouse "AB" brake equipment include the following:

Preliminary quick service. (a) Effective throughout entire length of long trains in level service. (b) Automatically compensated to conform with operating conditions in grade service.
Accelerated service application.
Service release insured.
Quick recharge following service operation.
Emergency at any time.
Protection against undesired emergency application.
Accelerated emergency transmission.
Controlled development of brake-cylinder pressure.
Higher brake-cylinder pressure in emergency.
Positive release following emergency.
Restricted release of brake-cylinder pressure.
Improved means of brake-cylinder lubrication.
Effective protection against leakage and dirt.

The essential parts of this new equipment are the "AB" valvular device; a double compartment reservoir—auxiliary and emergency; and a brake cylinder having several distinctive improvements.

The "AB" valve consists of three sections—the service portion, the emergency portion, and a pipe bracket arranged for permanent attachment to the car, which contains the quick-action chamber and the brake-pipe strainer. Separation of the emergency from the service functions prevents the occurrence of undesired quick action during a service rate of reduction, without impairing the desired quick-action feature. The bracket mounting of the valve permits either portion to be removed without disturbing any pipe connections.

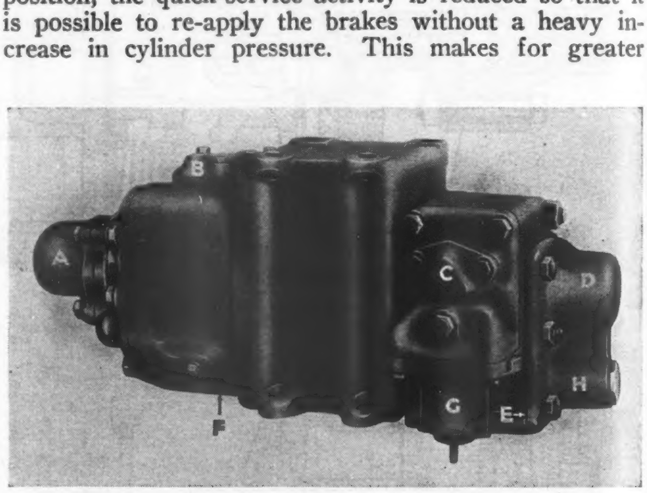
Service Applications

The service portion is so designed that the two basic requirements in securing prompt train retardation with smooth slack control—dependable and fast propagation of service application—are attained to a degree heretofore unrealized. Piston and graduating-valve movement alone closes the feed groove and initiates service application by a local venting of brake pipe to a bulb. The propagation rate is thereby greatly accelerated and every valve in the train functions dependably. Valves with normal friction will assume service position with the brake-pipe pressure drop resulting from equalization into the bulb. For valves having abnormal resistance to application movement through service use, a controlled vent port to atmosphere continues the brake pipe reduction, once initiated by the movement of the graduating valve, until the valve assumes service position, when this vent port is cut off. This assures all valves applying irrespective of variations in frictional resistance.

Not only can the engineman set the brakes lightly or heavily, as circumstances dictate, but also he can accomplish the successive application of brakes with a rapidity never heretofore attained. With a 150-car train equipped with the new brake the engineman can cause all brakes to apply, even when the brake pipe has its maximum tightness, with a five-pound reduction in equalizing-reservoir pressure, whereas with a similar train, equipped with "K" triples, less than half of the brakes, perhaps, will respond to such a reduction. Also, such a reduction with the "AB" equipped train will produce 10 lb. pressure in each brake cylinder throughout the train, where with a "K" train some three or four pounds only will be obtained. Moreover, the propagation rate of service application is more than twice as fast as with the present standard (700 to 900 ft. per second for quick service and 930 ft. per second for emergency), and is practically uniform with all degrees of brake-pipe leakage.

Great difficulty is encountered in maintaining the air-brake system and its piping in such a way that the leakage of air will be kept within reasonable limits. In recent years, however, in the effort to save fuel and cut down operating costs, the railroads generally have been able to keep well within the limits which were established for permissible leakage, and under which conditions the type "K" triple valve was designed to operate. The fact that the rate of air leakage has been materially reduced has adversely affected the efficiency of operation of these valves. The new "AB" triple valve, on the other hand, gives excellent service under these new conditions and, as a matter of fact, will operate effectively with "bottle-tight" or no-leakage conditions. Obviously, reliability of action under varying conditions is absolutely necessary. Brake pipe leakage, as well as the general condition of the valve, has little influence on the performance of the type "AB" equipment, whereas both of these factors affect the "K" performance materially.

While the quick-service feature provides for a predetermined minimum brake-cylinder pressure for level road operation, when cycling on descending grades and the brake is re-applied while the retainer is in holding position, the quick-service activity is reduced so that it is possible to re-apply the brakes without a heavy increase in cylinder pressure. This makes for greater



Front view of the "AB" valve

A—Accelerated emergency release cap. B—Cover with quick action chamber protection check and accelerated release check. C—Quick service limiting valve. D—Release insuring cap. E—Quick service volume exhaust. F—Quick action exhaust. G—Duplex release valve. H—Release insuring valve.

uniformity and flexibility of brake operation, assuring safe and smooth control of greater tonnage trains, with more uniform distribution of wheel temperature and brake-shoe wear. The improved quick-service feature, which assures such an effective and efficient brake throughout the entire length of long trains in level service, is thus automatically modified to conform with the best operating conditions for grade service.

A release stabilizing spring, combined with a relatively large charging port in normal release position, provides the stability of the valve required to prevent undesired application. This prevents piston movement to feed-groove-closed position and the initiation of quick action on the inevitable minor fluctuations of brake pipe pressure. The stabilizing spring also performs the function of a graduating spring.

The service portion of the "AB" valve has been so designed that the detrimental effects of high differential to release have been entirely overcome; irrespective of what their slide-valve differential may be, sluggish valves cannot cause a "stuck brake". The importance of the

improvement in release characteristics, especially for long train operation, can scarcely be over-emphasized. As a result the number of train delays, parted trains, overheated wheels, burned brake shoes, and slid-flat wheels will be materially reduced.

Two important factors combine to effect improved release functionings: (1) An emergency reservoir (which in service application is isolated and its pressure held at full charge) is provided to recharge the auxiliary reservoir during the initial stages of a release, thus conserving brake-pipe air and permitting quick restoration of its pressure throughout the train. (2) A simple means is used to assure that the valve will always move to release position when the brake-pipe pressure is but 1½ lb. above that in the auxiliary reservoir, even though the frictional resistance of the valve may be abnormal.

Emergency Applications

The emergency portion of the valve embodies many functional improvements. An emergency application can be obtained at any time, irrespective of the existing state of brake application and release.

Grade crossings and the increasing number of automotive vehicles have emphasized the desirability of so designing the brake that the engineman can make an emergency application shortly after he has initiated a service application. Before reaching a grade crossing, an engineman may apply his brakes in service, but thereafter circumstances may arise which cause him to wish to stop in the shortest possible distance—a situation which calls for an emergency brake application. With "K" triple valves an emergency application cannot be secured if the brakes have once been applied in service. With the "AB" brake, however, an emergency application is obtainable under all circumstances.

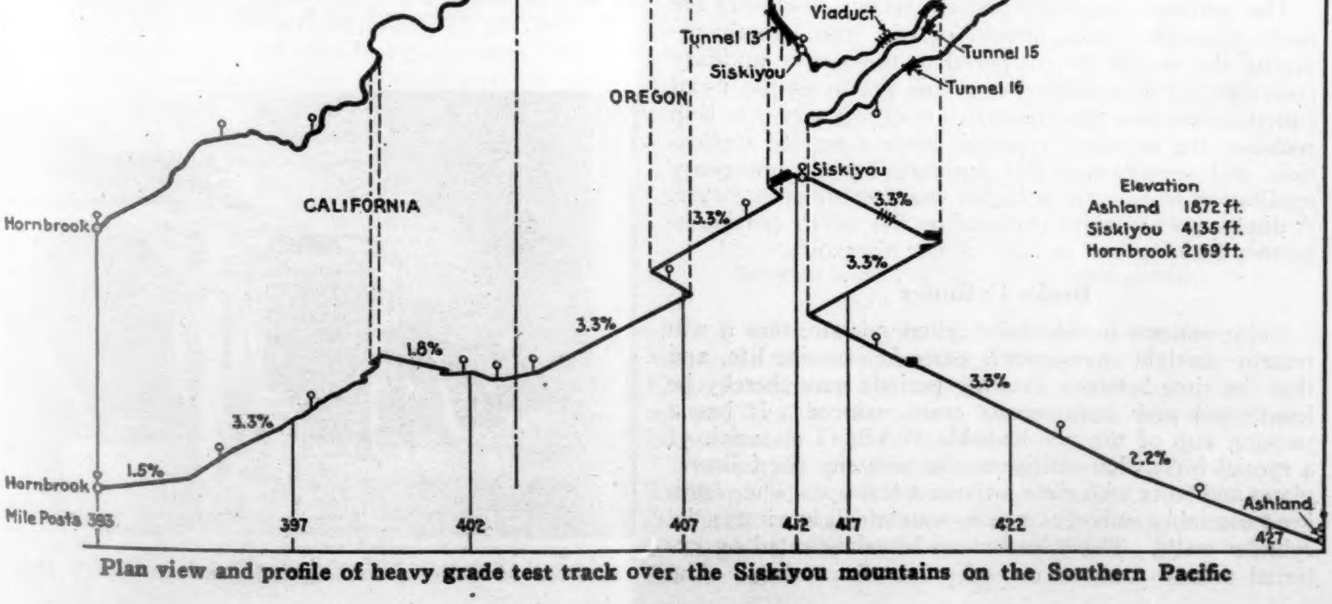
Adequate protection against undesired emergency application is also provided, thereby eliminating the hazards due to unintentional "dynamiting" when service application is intended, etc. The volume of the quick-action chamber must be small and, if permitted to overcharge during full release movement of the brake valve, could cause undesired emergency. To prevent such an overcharge, the quick-action chamber automatically discharges any surplus air to the large emergency reservoir which is below normal pressure during the first stage of brake release.

The development of pressure in the brake cylinder in emergency takes place in three stages. First, the cylinder pressure builds up rapidly to about 15 lb. in order that the brake shoes may be brought quickly in firm contact with the wheels; second, the pressure builds up slowly during the period of slack adjustment; and third, pressure is built up rapidly to the maximum value. The maximum value of the cylinder pressure from an initial charge of 70 lb. is 60 lb., or an increase of 20 per cent above the maximum pressure obtainable in service. Since an emergency application is always available, 60 lb. cylinder pressure can be procured whenever wanted, provided that the car reservoirs were originally charged to 70 lb. pressure.

It is obvious that the second stage, during which slack adjustment occurs, can be shortened if slack adjustment has previously been brought about by a service application. Consequently, the "AB" triple is so arranged that the second stage is proportionately shortened to correspond with the degree of cylinder pressure existing when the emergency application is initiated. The second stage disappears completely if a prior service application has resulted in about 30 lb. cylinder pressure. The mechanism which controls the development of cylinder pressure in emergency is so devised that variations in control are readily available.

Release After Emergency

Following emergency operation, the release of every



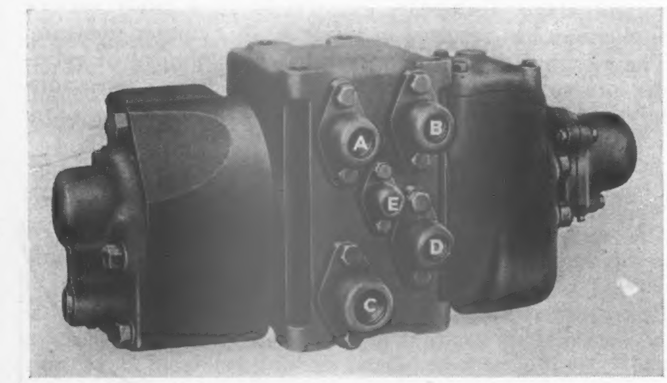
Plan view and profile of heavy grade test track over the Siskiyou mountains on the Southern Pacific

brake in the train is effected quickly and dependably. Since the "AB" brake develops 60 lb. emergency cylinder pressure, means have been incorporated in the valve which obviate the necessity of restoring the brake pipe pressure above 60 lb. in order to accomplish a release. If it were necessary to charge the brake pipe to more than 60 lb. to effect a release after emergency, the release would be slow and uncertain. The brake has been so designed, therefore, that when a release after emergency is initiated, after the brake-pipe pressure has increased to a predetermined value, air from the auxiliary reservoir and brake cylinder flows for a predetermined time to the brake pipe. As a result of this novel arrangement, the brake-pipe pressure is increased and the auxiliary reservoir pressure decreased, which combination brings about a prompt and certain release.

Other Special Features

The dirt collector, of improved design, is combined with the cut-out cock and is attached directly to the bracket, thus eliminating pipe joints and reducing the branch-pipe volume. A special form of strainer in the pipe bracket prevents dust that is too fine to be caught by the dirt collector from reaching the packing rings and slide valves, thus greatly extending the life and dependability of the brake.

Reinforced flange unions for all pipe connections insure permanently air-tight joints, and eliminate pipe failures at connections.



"AB" valve, showing pipe bracket face and re-inforced pipe fittings

A—To auxiliary reservoir. B—To emergency reservoir. C—To brake pipe. D—To brake cylinder. E—To retaining valve.

The combined auxiliary and emergency reservoirs are made of welded steel, instead of cast iron, greatly reducing the weight as compared to the single auxiliary reservoir. The auxiliary reservoir performs the usual function, whereas the emergency reservoir serves to help recharge the auxiliary reservoir after a service application, and supplements the auxiliary during emergency application to provide a higher brake-cylinder pressure. A duplex release valve is placed on the service portion to permit draining one or both of the reservoirs.

Brake Cylinder

Improvements in the brake cylinder insure that it will remain air-tight over greatly extended service life, and that the time between cleaning periods may thereby be lengthened and maintenance costs reduced. It has a packing cup of the non-leakable WABCO material, of a special form, that eliminates the necessity for follower plates and bolts with their attendant leakage. The piston head assembly embodies a felt swab which lubricates the cylinder walls. The cylinder can be relubricated by external means, without necessity for dismantling. The piston rod is also equipped with packing rings to prevent the entrance of dirt and moisture, the necessary "breather" being placed on the non-pressure head.

Savings Which Will Be Effected

The "AB" freight-brake equipment makes possible the safe and efficient operation of trains up to 150 cars in length. It weighs 497 lb., or only about 47 lb. more than the "K", and is of relatively simple construction.

The working parts are designed for long life and are protected against leakage and dirt; this will greatly reduce the maintenance costs. The equipment is specially designed to facilitate inspection and cleaning, and it is expected that the interval between such inspections and cleanings can be extended from the 15 months now required, to 36 months or longer.* Entirely aside from the operating advantages, this saving in maintenance will largely offset the increased cost of the new brake.

In addition to these, there will, however, be other important savings. The positive action of the new brake will practically eliminate the interruption of train schedules and yard movements caused by uncertain brake action. The number of slid-flat and damaged wheels will be reduced. Loss and damage to both lading and equipment, as well as personal injuries due to inadequate brake functioning, will be reduced. Savings will be made because of being able in many cases to slow down without stopping; less time will be consumed in releasing the brakes after stops; it will be possible to operate at higher maximum speeds on the level, and with increased tonnage down grade. Time will be saved in releasing the brakes after trains have been separated on crossings, or when taking water, etc. There will also be a saving in brake-shoe wear, due to the more uniform distribution of brake pressures on all the shoes in a train.

Service and laboratory tests demonstrate that the use of "AB" equipment in trains with the type "K" triple valves makes the operation of the train brakes as a whole more effective than with the "K" valves alone, so that a steady improvement in the efficiency of operation can be looked forward to as the number of "AB" equipments in service increases.

The new "AB" brake equipment is being offered by both the Westinghouse Air Brake Company and the New York Air Brake Company.

* The interchange rules were changed January 1, 1933, increasing the periodical cleaning of air brakes from to 12 to 15 months. Instructions as to the type "AB" were also issued as follows: "In order to determine the average length of time these new brake equipments may be operated in service without being cleaned and lubricated, periodical attention must not be given them until a defect develops. Therefore, the type "AB" valve and brake cylinder must not be cleaned nor lubricated."

* * *

Interior of modern, well-lighted passenger-coach shop

Modern Locomotive Valves And Valve Gears Analyzed

Part III

By Walter Smith*

Limitations and possibilities of present steam distribution valves—Importance of adequate maintenance methods strongly emphasized

THE fact that the piston valve has been able to hold its place as standard in locomotive service for the past 25 years speaks well for its merits. The outstanding reasons for the adoption of the piston valve in locomotive construction are: Reliability in service; ease of maintenance; adaptability to changes in locomotive design and operating conditions; cylinder castings of simple design with the possibility of making ports short and nearly straight; flexibility as to location of cylinders and valve gear; accessibility for inspection and maintenance; ease of arranging valve details to obtain the required valve events; possibility of selecting valve diameter to give a required port area.

In spite of the splendid service the piston valve has rendered during this long period, it is open to rather severe criticism. The objectionable features of the piston valve are as follows:

(1) Owing to the fact that metal slides on metal, there is considerable friction between the valves and bushings, and this is increased with higher boiler pressure. It becomes increasingly difficult to provide adequate lubrication, with the result that engine power is absorbed at the expense of drawbar pull.

(2) It has poor drifting qualities, and cannot relieve excess pressure in the port after the manner of the slide or poppet valve.

(3) There is more or less leakage, even when the bushings are accurately bored, and packing rings carefully fitted. This leakage increases with higher steam pressure, and not only causes a loss in effective pressure, but adds to the negative pressure as well. It also contributes to lubrication difficulties because of the tendency for oil to blow through.

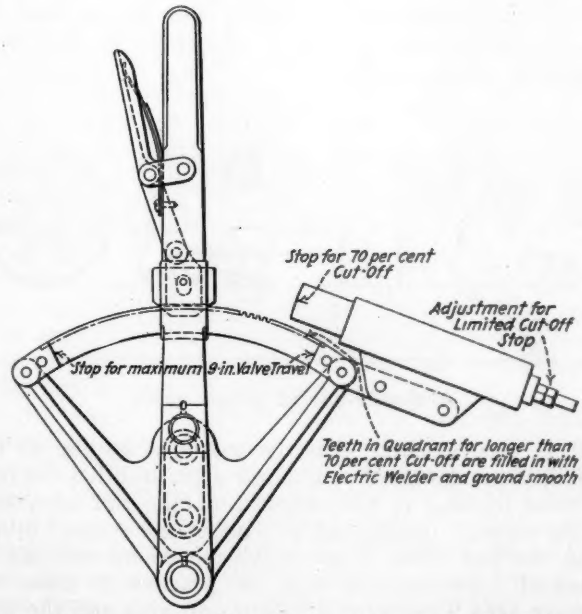
(4) The port opening is only partially effective, due to the necessary introduction of numerous bridges, which cut down the aggregate area of the valve ports and baffle the steam as it passes through the valve chamber. Furthermore, the port area on the top half of the valve bushing is less effective than that on the bottom half, due to excessive port friction.

Sizes of Piston Valves

Before the advent of high steam pressure, high superheat, and long valve travel, it was considered good practice to use piston valves approximately 55 per cent of cylinder diameter, with the maximum diameter limited to 16 in. This ratio worked out satisfactorily for small and moderately-sized cylinders, even when the valves were actuated by short-travel valve gears, but the very large cylinders were handicapped at short cut-offs by insufficient port areas. The fact that the cylinder area increases with the square of the diameter indicates the necessity for more liberal port areas with large cylinders. The most noticeable characteristic of locomotives with restricted port areas is the longer cut-off required, and the higher back pressure developed, for a given power output.

Without question, distribution valves should be designed as small and light as consistent, in order that the duty on the valve gear may be relieved as much as possible. The Pennsylvania Railroad tests of measurements of the stresses in the valve stems gave definite figures showing the reduced stress by using valves of the minimum diameter. However, maximum horsepower capacity is a factor of greater importance, and valves should be large enough to insure adequate port areas for maximum horsepower requirements.

The recent trend in locomotive design toward increased boiler pressure, higher superheat, and comparatively smaller cylinders has improved cylinder performance. These developments, along with the introduction



Reverse lever limited cut-off arrangement

of long valve travel, justifies the use of smaller valves than those formerly considered necessary. Piston valves 12 in. in diameter can now be used safely with cylinders up to 27 in. in diameter. Sixteen-inch valves are no longer specified on new power.

The saving in weight accomplished by the use of valves of smaller diameter is shown by the following tabulation of approximate weights of valves and stems: 12-in. valve, 200 lb.; 14-in. valve, 260 lb.; 16-in. valve, 325 lb.

* Formerly associated for a period of 14 years with O. W. Young in the development of long-travel gears and subsequently with the Pyle-National Company in the promotion of limited cut-off. The present article is the final installment of a three-part article, the first of which was published beginning on page 9 of the January *Railway Mechanical Engineer*, and the second beginning on page 45 of the February *Railway Mechanical Engineer*.

It is worthy of note that with smaller cylinders and valve chambers there is less cylinder clearance and the area through which heat can be lost by radiation is also reduced. Both of these features contribute to more efficient use of steam.

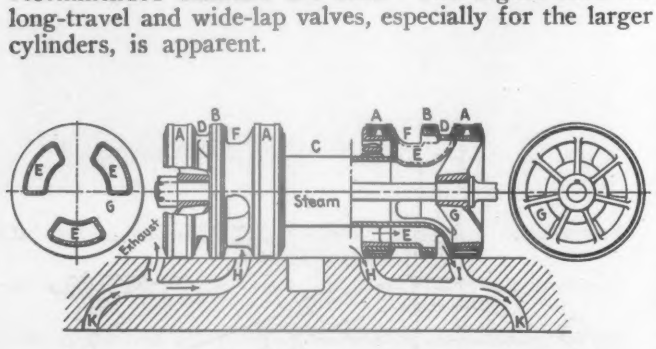
Double-Ported and Multiple-Ring Piston Valves

Double-ported piston valves give double openings for both admission and exhaust, and theoretically should improve locomotive performance because a higher admission pressure can be maintained up to the point of cut-off, and a lower back pressure during the period of exhaust. However, due to mechanical difficulties from increased weight and friction for additional admission and exhaust rings, these valves have not proved satisfactory, except in slow-speed service.

Valves which must depend upon the pressure-balancing of rings, and the sliding of metallic surfaces, for their operation offer considerable frictional resistance and require the best of lubrication. Multiple-ring arrangements increase frictional service and make lubrication more difficult. For that reason, the simplest possible ring arrangement causes the least drag on the valve gear, and gives the best all-around performance.

Piston-Valve Port Areas

In order to prevent wire-drawing of the steam into the cylinders at short cut-off, it has been established that a ratio of 40 to 1 between piston area and port area at 25 per cent cut-off is necessary. Also, that in order to insure freedom of exhaust, a ratio of 10 to 1 between piston area and the exhaust area at the end of the stroke is required. The table shows how these ratios work out for different cylinder diameters, and gives the port opening necessary to maintain the areas when valves of the recommended diameter are used. The urgent need for long-travel and wide-lap valves, especially for the larger cylinders, is apparent.



A double-ported piston valve

It is very essential that the passages leading to the cylinders are designed with ample area, and that the port in valve bushing is wide enough to take full advantage of the exhaust opening at the end of the stroke; otherwise, the full effect of the valve movement will not be obtained. Formerly, it was the practice to make the passage area 9 per cent of the piston area and the port area 25 per cent over the passage area. Since the introduction of long valve travel with valves arranged for wide steam lap, it has been found necessary to proportion the width of the port to the steam lap. In order that the full possibilities of the wide steam lap may be realized, the width of the port should be as great as the exhaust opening at the end of the stroke, which is: *Steam lap plus lead plus exhaust clearance.*

Since the exhaust opening at the end of the stroke determines the initial back pressure, there is nothing to be gained by a wider port. And it is highly desirable to keep the port as narrow as possible, for the reason that an increase in port width means a wider bull ring which increases the valve weight and adds to the frictional surface.

Poppet-Type Steam Valve May Be the Solution

The piston valve has played its part in the development of the American locomotive, and now there is the possibility that it will be abandoned in favor of some type of poppet valve which does not require lubrication.

The principal advantages of poppet valves are:

(1) Better adapted for handling high-pressure and high-temperature steam, because the valves are light and function with very little friction. Lubrication is not a problem.

(2) Separate admission and exhaust valves which permit of better control of valve events, and also reduce the loss from excessive cylinder clearance, and from heat exchanges between steam and cylinder walls by keeping the inlet and outlet channels apart.

(3) Inlet and exhaust openings can be made to occur nearly twice as rapidly as with the conventional piston valve, and with a wide-open port at all points of cut-off.

(4) Drifting is greatly facilitated without the necessity for drifting or by-pass valves, due to inlet valves automatically lifting from their seats and connecting the cylinder, front and back of the piston, through ample areas. Carbonization likewise reduced.

(5) Possibility of operating at shorter cut-offs than with piston valves without excessive compression.

Credit must be given to Italian and Austrian railways for developing poppet valves for locomotives. The Lentz poppet valves developed in Austria make use of a conventional design of Walschaert valve gear which operates a swinging cam shaft. The Caprotti poppet valves and gear are an Italian invention. In this design, the valves are also cam-operated, and the shaft is propelled by, and at the same speed as, the driving axle of the locomotive. Up to the present time, only experimental applications of poppet valves have been made in this country. The Caprotti valves and gear have been applied to a few locomotives, and the Delaware & Hudson has equipped two locomotives with oscillating poppet valves actuated by a Walschaert valve gear of the conventional design.

Without question, the problem of adapting poppet valves and some form of rotary or oscillating valve gear to our present service requirements is capable of ultimate solution. The experimental applications so far made in this country indicate that there is still considerable development work to be done before poppet valves can be considered commercially practical. As previously stated, the fundamental requirements in railroad service are simplicity, ruggedness and dependability.

Maintenance of Piston Valves

From the standpoint of efficient and economical locomotive performance, there is probably no other maintenance feature which will pay larger dividends than the proper conditioning of piston valves. At best, piston valves are only approximately steam-tight, and can be made to function only with a certain degree of perfection in the control of steam distribution. Excessive valve leakage not only wastes coal and water, but it dissipates power because of the detrimental effect it has on valve and cylinder lubrication. Piston valve blows make proper lubrication difficult, or impossible, of attainment.

In order to insure the best possible performance from piston valves by reducing steam leakage and facilitating lubrication, it is necessary to use a certain degree of refinement in maintenance. The object desired is to secure freely acting rings which will have a perfect bearing on the cage. This requires the following common and approved practice:

(1) Valve bushings must be smoothly bored after the bushings are pressed, or pulled, in place in order to insure proper alinement, and to obtain an accurate bearing surface. Furthermore, the cages must be rebored after a prescribed service period, or when the periodical inspection shows that undue wear has taken place.

(2) Valve rings must be ground, or turned, to the exact bore of the bushing after they have been cut and closed on an arbor.

(3) Valve rings and bull rings must be carefully fitted so that the rings do not bind or have too much clearance, which would cause the rings to stick or roll in the grooves.

The practice of boring valve cages to size before they are pulled or pressed in place is to be condemned, for the reason that the pulling or pressing operation subjects the bushing to severe treatment and is almost sure to cause some distortion of the bearing surface. Reboring the cages after they are in place restores the accuracy of the bore. Equally as bad as the preceding consideration is the practice of applying snap rings that have not been re-turned after cutting. This practice results in considerable steam leakage past the periphery of the rings, because of the tendency for snap rings to spring out of round when parted. Turning the rings to the exact size of the bushing after they have been cut insures nearly perfect fitting rings from the start, with the result that steam leakage is greatly reduced, lubrication is facilitated, and the time necessary to break in valves is shortened.

After valve chambers have been bored and new rings fitted, it is a short-sighted policy to place locomotives in service without some breaking in. It takes a certain amount of time before the rings become seated and the surfaces glazed to the extent that lubrication becomes effective. There are many cases on record where valves and cages that have been very carefully fitted were damaged the first trip because the engine was working to capacity before it started to lubricate.

Wear of Valve Bushings

Unquestionably, the most troublesome problem in connection with the maintenance of piston valves is the tendency for the steam valve rings to wear a shoulder on the bridges of the valve bushings. While this trouble dates back to the introduction of the piston valve, it did not become serious until the advent of superheaters. In analyzing the cause, it seems highly probable that the shoulder is worn by the steam ring when the valve is traveling at the running cut-off and may be due to one or a combination of the following causes:

(1) The inability to maintain the oil film between the metallic surfaces, when the locomotive is operated for prolonged periods at a short point of cut-off and with wide-open throttle.

(2) The difficulty of maintaining adequate lubrication because of boiler feedwater trouble, which is aggravated by the present deficiency in steam space and by the miscellaneous feedwaters taken on long locomotive runs.

(3) The carbonization of the oil in the valve chamber because of failure to break completely the vacuum, which is formed in the cylinders when the main throttle is shut off.

Naturally and logically, the greatest wear takes place on the bridges, because there is less bearing surface where the valve rings travel over the ports. And as the steam ring only sweeps about two-thirds of the length of the bridge in the running cut-off, it is reasonable to assume that a shoulder will be formed if the wear is excessive. The reason for excessive wear is the abrasive action which takes place between the bearing surfaces when the lubrication is gummed (a) by grit and sediment from a boiler which is functioning badly, or (b) by the gritty substance which is formed when cinders and smoke-box gases are drawn from the front end and carbonized with the oil. The practice of drifting with the reverse in the running cut-off, and with insufficient steam admission to break the vacuum, is especially harmful. Lengthening the cut-off at the same time that the throttle is closed not only assists in relieving the vacuum, but it permits the steam rings to travel over the full length of the bridges; and thus is helpful in preventing the formation of the shoulder.

For years, various attempts have been made to prevent the shouldering of valve bushings by improved design and recourse to metallurgy. While some of the methods devised to eliminate or reduce the excessive wear at the bridges have been beneficial, they do not get at the root of the trouble. Excessive bridge wear can be reduced (1) by the introduction of more bridges, (2) by widening the bridges and (3) by resort to diagonal bridges. From the standpoint of steam effectiveness, all of these methods are undesirable because they reduce the port area. As regards changes in the shape and width of rings, tests made with a variety of different types disclosed the fact that very little can be accomplished by redesigning the rings.

If it were not for the aforementioned operating difficulties, this problem could, no doubt, be cured by metallurgy. Valve bushings made of refined iron, which is hard and close-grained, and which gives a glazed or polished bearing surface, should insure resistance to wear and diminish sliding friction. Nitrided steel valve bushings have been proposed as a possible solution to this difficult problem. These bushings would have an extremely high hardness, and, when lapped to a very high polish, the hardness would never be disturbed as the temperature range in the valve chamber is well within that used for nitriding purposes.

Creeping of Valve Bushings

Another troublesome problem in connection with the operation and maintenance of piston valves is the tendency for two-piece valve bushings to creep apart after they have been properly spaced in the valve chamber. The early applications of piston valves were made with continuous bushings, which were advantageous in this respect. The tendency for split bushings to creep apart not only disturbs the valve setting, but also causes variations in the lead, lap and exhaust clearance of the valves. Invariably, the bushings move out, because, with the valves in place, the pressure in the valve chamber tends to force them apart. When the bushings move out, the lead of the valve is reduced and the steam lap and exhaust clearance are increased. This trouble is much more prevalent than is appreciated, and is an obstacle to the maintenance of standard valve details.

It would be logical to assume that the ordinary threaded keeper bolt, when properly fitted, would anchor the bushings. Here again, the answer is to be found in the inability always to maintain adequate lubrication under the existing operating conditions. Naturally, the most trouble occurs in bad water districts and on classes of locomotives which are difficult to lubricate. There are many cases on record where keeper bolts have been sheared off. Where the threaded dowel has been found inadequate, various supplementary methods have been devised to hold the bushings in place. The application of a metal block between the end of the bushing and end wall of the steam chest is an effective means when the block is properly fitted.

Distortion of Valve Chambers

Since the introduction of steel cylinders and the one-piece bed frame with integral cylinders, a new problem has developed which as yet has been given very little consideration. It has been observed that, under the high

temperatures now common in locomotive service, there is a tendency for the valve chambers and cylinders to distort slightly. Under the intense heat, the expansion of the chamber is not uniform, probably on account of the irregularly shaped casting forming its walls and also because the shrinkage strains have not been removed entirely by the annealing process. This is a metallurgical problem and, no doubt, can be overcome by the use of alloys and by proper heat treatment. At any rate, it emphasizes the importance of thoroughly annealing steel cylinder castings.

This tendency for the valve chambers and cylinders to grow is more prevalent than is appreciated and results in steam leakage at the periphery of the packing rings. In extreme cases the cylinder leakage may be sufficient to result in loss of power, and the valve leakage may be sufficient to cause valves to sound out of square when their mechanical movement is square.

In this connection, the fact should not be overlooked that, in order to insure freedom of the valve in the chamber in case of possible distortion with cast-steel cylinders, it is advisable to use slightly greater valve clearances than with cast iron cylinders. A bull ring clearance of 3/64 in. and a snap ring opening of 3/64 in. will meet every requirement.

Engine Failures Charged to Valve Gears

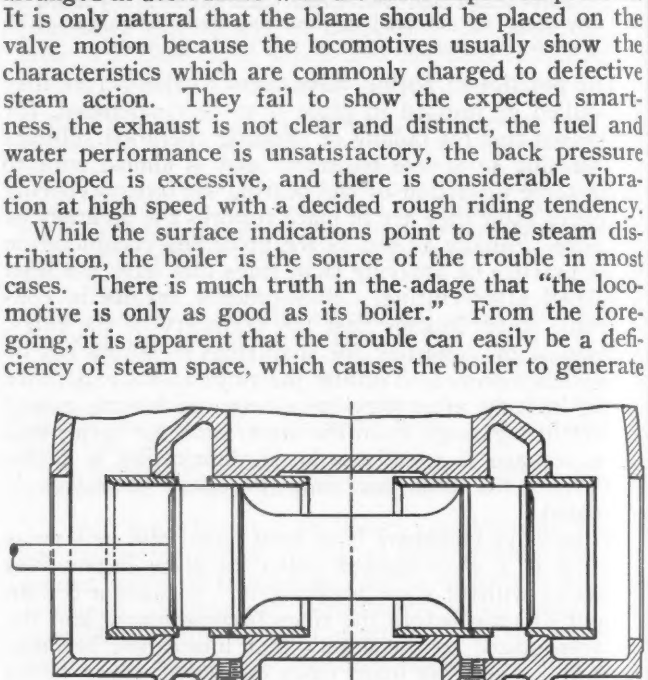
Because of the operating difficulties mentioned, valve gears at times must withstand very severe punishment, and, in spite of the fact that present valve gears are masterpieces of rugged simplicity, occasionally failures result. Naturally, valve lubrication difficulties are responsible for a large number of these failures. While insufficient valve lubrication causes an overload on the valve mechanism and eventually may result in failures, by far the greater number of failures occur when lubrication is destroyed entirely. It has been shown the lubrication can be destroyed by the vacuum that is produced when the locomotive is drifted at high speed or by a boiler which is foaming badly. Then there are other causes such as the washing of the valves by a defective open-type feedwater heater. Besides these operating difficulties, there are lubrication troubles, which are due to broken oil pipes and force-feed lubricator defects.

A careful investigation of valve-gear failures often discloses the fact that the failure occurred when the throttle was shut off at high speed. The engineer thoughtlessly may have closed the throttle tight on approaching a stop signal. When the throttle is shut off tight at high speed, the lubrication is destroyed in a split second, and the resulting tendency for the valve to grip or seize in the chamber may cause failure of an overstressed valve-gear member. There is another possible source of failure, and that is the practice of lengthening the cut-off at high speed at the time the throttle is closed. While this practice is beneficial from the standpoint of breaking the vacuum in the cylinders, it gives the valve gear severe treatment, because the valve is required to sweep over a surface that probably has been coated over with carbonization during the time the locomotive was operating at a short cut-off.

It is worthy of note that failures from hot valve-gear bearings may be on account of insufficient valve lubrication. The overload which the bearing is required to carry may cause a case-hardened pin and bushing to heat. This is not an infrequent cause of hot link-block pins on the Walschaert valve gear, which have been a source of trouble ever since the introduction of this gear.

It sometimes happens that locomotives of a new design fail to meet expectations, not only with respect to speed, power and economy, but also from the standpoint of smooth working conditions. Before the cause of the poor performance is thoroughly analyzed, there is a decided tendency to charge the inefficiency to the valve and valve-gear arrangement; oftentimes, in spite of the fact that the details of the valves and valve gear have been arranged in accordance with the most improved practice. It is only natural that the blame should be placed on the valve motion because the locomotives usually show the characteristics which are commonly charged to defective steam action. They fail to show the expected smartness, the exhaust is not clear and distinct, the fuel and water performance is unsatisfactory, the back pressure developed is excessive, and there is considerable vibration at high speed with a decided rough riding tendency.

While the surface indications point to the steam distribution, the boiler is the source of the trouble in most cases. There is much truth in the adage that "the locomotive is only as good as its boiler." From the foregoing, it is apparent that the trouble can easily be a deficiency of steam space, which causes the boiler to generate



Arrangement of the Franklin limited cut-off starting ports

steam carrying entrained moisture. This defect lowers the superheat, and usually causes lubrication difficulties, which absorb engine power. Furthermore, the circulation in the boiler may be too violent, the steam dome may be located too near the crown sheet, or there may be other reasons to make the boiler carry water badly. Then there is the possibility that the front-end design or arrangement is defective and necessitates the use of a comparatively small exhaust nozzle; or the gas area through the boiler may be restricted, with the result that a high back pressure is required to overcome the loss in draft.

It is a common misconception that a sharp clear exhaust always indicates effective valve movement. It more often indicates efficient boiler and front-end performance. In this connection, it is also worthy of note that maximum steam effectiveness requires cylinders with steam and exhaust passages of large dimensions and of correct outline, and sufficient steam area through the superheater, throttle and steam pipes in order to prevent excessive pressure drop between the boiler and

cylinders. These details are worthy of consideration in analyzing causes of poor performance.

Conclusions

From the foregoing, it is apparent that the present types of valves and valve gears have been developed to a high standard of efficiency and are responsible, in no small measure, for the phenomenal performance of present-day high-powered locomotives. Regarding possibilities for future locomotive improvements, increased power output probably is the most attractive. Since boiler sizes cannot continue to increase, the matter of evolving larger capacity locomotives concerns the more effective utilization of steam. It is, therefore, necessary to concentrate attention on the problem of developing high horsepower at relatively low rates of steam consumption. Unquestionably, it will be necessary to resort to increased steam pressure and higher degrees of superheat for the greatest portion of the improvement; but the reduction of back-pressure horsepower and more effective steam distribution are factors well worthy of attention.

Ratios Between Piston Area and Port Areas at 25-Per Cent Cut-Off Necessary To Insure Maximum Horsepower

Cylinder diameter, in.	Piston area, sq. in.	Admission port area, sq. in.*	Exhaust area, end of stroke, sq. in.†	Valve dia., in.	Port length, cir. less bridges, in.	Admission port opening, 25-per cent cut-off., in.
23	415	10.4	41.5	12	28.699	3/8
24	452	11.3	45.2	12	28.699	3/8
25	491	12.3	49.1	12	28.699	7/16
26	531	13.3	53.1	12	28.699	1/2
27	573	14.3	57.3	14	33.98	7/16
28	616	15.4	61.6	14	33.98	1/2
29	661	16.5	66.1	14	33.98	1/2
30	707	17.7	70.7	14	33.98	9/16
31	754	18.8	75.4	14	33.98	9/16

*At 25-per cent cut-off, it equals 1/40 of the piston area.
† Equals 1/10 of the piston area.

There is reason to believe, however, that the possibilities for improvement of major character in present valve arrangements are now limited and that basic changes in design are necessary to meet the new operating conditions. In the foregoing, attention has been focused on the vital problems in connection with the design, operation and maintenance of piston valves and our present valve gears. It has been shown that the lubrication of piston valves is a factor of extreme importance and that, because of certain basic defects in this type of valve, with longer travel, higher boiler pressure and increased superheat, proper lubrication becomes increasingly difficult of attainment. While the problem may not offer insurmountable difficulties, it is a serious obstacle to further progress. The poppet valve and a suitable valve mechanism has been suggested as an alternative.

Although a few railroads still use conservative ratios and proportions in valve and valve-gear arrangements, the predominating practice is to take full advantage of the longer valve travel provided by improved valve gears. It has been shown that by the use of long-travel valve gears, it is possible to improve greatly the ratios between port and piston areas, and thus very high initial pressure against the piston is insured up to the point of cut-off and, in addition, back pressure is materially reduced by the greater exhaust opening. Furthermore, this trend toward longer valve travel has been a logical means of keeping up with increased cylinder volumes. Moreover, the most striking characteristic of the limited cut-off, from the standpoint of steam control, is the decided increase in valve travel which it provides at short cut-offs. Finally, it seems reasonable to conclude that, because of this feature and the unquestioned steam economy of the restricted cut-off principle, the limited cut-off should be considered the outstanding accomplishment in locomotive valve and valve-gear development.

The vital importance of a large-capacity boiler, which meets all cylinder requirements and which functions well, under all operating conditions, has been stressed. The economy and improved performance made possible by refinements and improvements in the valve and valve-gear arrangements can be nullified almost completely by improper boiler and front-end design. When the steam space in the boiler is restricted wide port openings and quick valve movement only tend to aggravate the tendency to raise the water in the boiler, with the result that a higher percentage of moisture is carried into the superheater. Then, improperly-designed and arranged front-end appliances, which make a high back pressure necessary for the production of draft, still further limit the effectiveness of steam action. If the advantages from improved valve and valve-gear arrangements are to be actually realized in service, the boiler must co-ordinate fully under all conditions and requirements of operation. The boiler always has been, and still remains, the controlling factor in locomotive performance.

Self-Alining Roller Bearing

A NEW line of single row self-alining radial roller bearings is being offered by the Shafer Bearing Corporation, Chicago. A single-row Shafer concave bearing is used with rollers operating between a straight outer race and a convex inner race. This type bearing has full self-alinement compensating automatically for misalinement due to inaccuracies in machining or shaft deflection under load. A feature of these bearings is that the retainer is omitted, making it possible to use approximately 50 per cent more rollers in the bearing than would otherwise be the case. The thrust is taken by means of hardened and ground thrust plates. These bearings are obtainable either in pillow-block units such as the one illustrated, or separately for shaft sizes from 9/16 in. to 2 3/16 in. diam. inclusive.

Shafer pillow block containing radial self-alining roller bearing

Ratios of Modern Locomotives*

Part I

By A. I. Lipetz†

The Type E superheater, the long travel valve motion and certain changes and refinements in proportions have tended to increase the power of modern locomotives beyond that indicated by Cole's ratios. The author develops a revised method of easily applied coefficients for use with modern locomotives

No one method or formula can express the tractive force of all locomotives. So many variables affect the performance of a steam locomotive that attempts to devise a universal formula have never been successful. As an example, it suffices to say that in designing steam cylinders the proper dimensioning and shaping of steam ports and bridges, and the relative location of exhaust- and live-steam passages, are of great consequence as regards the question of losses caused by wire drawing and condensation. No formula can express the ability of the designer to provide an economical cylinder. The most that can be done by a formula is to express the average results of a well-proportioned locomotive of a design that is characteristic of a certain period of locomotive development, and to give an idea of the power of a steam locomotive under ordinary working conditions with a degree of accuracy sufficient for practical purposes.

With this end in view, the author attempts in what follows to provide means of quickly and fairly accurately evaluating the horsepower and tractive force of a modern two-cylinder, simple-expansion locomotive equipped with a superheater of sufficient size, with or without a feed-water heater, with a proper valve motion, and with other parts characteristic of modern locomotive design.

For locomotives of an earlier period, Cole's formulas are sufficiently accurate, and although the method about to be explained could also be extended to cover all locomotives, no attempt has been made to supersede the Cole method for locomotives of pre-war design.

Tractive Force

The basis of all tonnage and speed-time-distance calculations is the tractive force of a steam locomotive. Of the different tractive forces that are sometimes being used, the basic one is the "indicated tractive force," which is the direct result of the work of steam in the cylinders. The "rail tractive force," which is the imaginary force applied to the rim of the wheels, and the drawbar pull on the tender drawbar, can be found from the indicated tractive force, if the engine friction and total locomotive resistance are known. The object of this paper is to establish a method and figures for the calculation of indicated tractive force as a function of speed.

A method of plotting the tractive-force curve on the basis of cylinder sizes only, using the rated tractive force and certain factors, irrespective of the size of boiler, is in principle incorrect. Nevertheless, in practice, it can give good results for the reason that in a locomotive of a certain period and of conventional proportions, the sizes of the locomotive boiler and cylinders are in a certain ratio to each other. However, as with improvement in locomotive design the boiler becomes larger in proportion to the engine, in order to meet the increased speed requirements of traffic, the formulas based on cylinder sizes and Cole's factors begin to give too low values.

Mr. Cole himself introduced the idea of boiler horsepower. He determined it to be equal to the maximum evaporation in pounds per hour divided by 20.8 for superheated steam, this figure representing the consumption of steam in pounds per horsepower-hour, in-

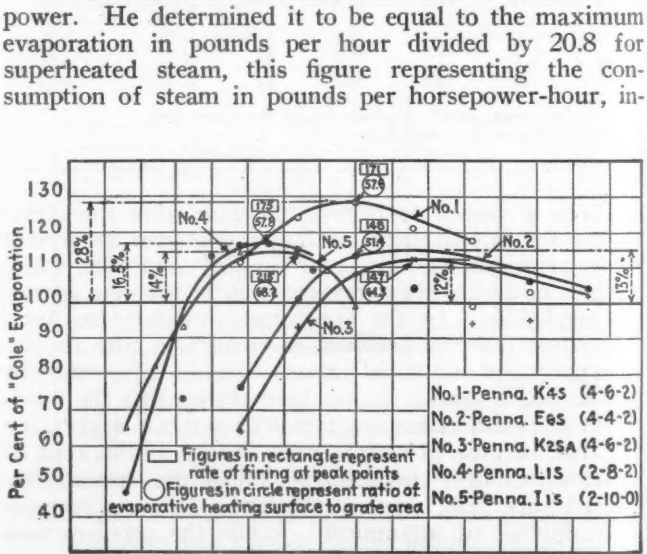


Fig. 1

cluding auxiliaries.[1] This made it possible to determine what is called the boiler percentage, which means the ratio of maximum cylinder horsepower (at 1,000 ft. per min. piston speed) to the boiler horsepower, the maximum cylinder horsepower being found from the Cole formula, and the boiler horsepower as stated above. Cole recommended designing locomotives with boiler percentages as close to 100 per cent as possible. In this case his method of plotting the tractive-force curve would be correct, strictly speaking, at least for one point, namely, 1,000 ft. per min. piston speed. However, for loco-

*Abstract of a paper presented at the annual meeting of the American Society of Mechanical Engineers at New York. Contributed by the Railroad Division.

†The author is consulting engineer of the American Locomotive Company.

[1] "Locomotive Ratios," p. 9; also "Locomotive Handbook," American Locomotive Co., 1917, p. 64-65.

motives with larger or smaller boilers, the boiler percentage had no effect on plotting the curves. Therefore some locomotive builders and railroads have already found it necessary to make corrections in the Cole factors in relation to the boiler percentages. This in fact is a roundabout way of figuring the correct tractive force for a piston speed of 1,000 ft. per min., and an approximate value for other speeds.

Direct Methods of Establishing Tractive-Force Values

There are at least two possible direct methods for establishing the tractive-effort values for different speeds —one, which might be called the analytical method, and the other, an empirical method.

The first, the analytical method, is logical and seemingly very simple; however, in order to give good results, it requires a number of corrections, which can be determined only from actual experience. It would seem very simple, if the evaporation of the boiler and principal dimensions of the locomotive engine are known, to calculate the amount of steam per stroke for each speed and the tractive force for that speed resulting from the work of the figured amount of steam.

This method was proposed and used in the early years of locomotive development, and for a long time it was considered to be the only possible method in view of

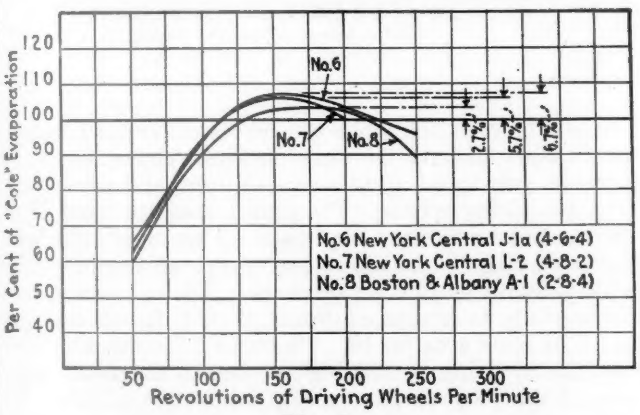


Fig. 2

its comprehensibility. It is rational in principle, and therefore had a great many adherents. The difficulty with the method, however, lies in the fact that two important and very complex factors are neglected: first, the cooling of steam in the cylinder, and second, the distortion of indicator cards due to speed, both of which cause considerable losses.

The cooling of steam in the cylinder, or what is known as the heat exchange between the steam and the cylinder walls (and heads), cannot be expressed by any theoretical formula. A large number of studies have been made, some of them employing very complex forms of mathematical analysis, in order to establish the cooling effect of the cylinder, but none of them has given practically satisfactory results, as too many variables are involved. With highly superheated steam the conditions are slightly better and some formulas can be established, but even then, resort must be had to empirical figures from tests, as will be shown later.

The second factor, distortion of indicator cards, depends upon the valve-motion characteristics, steam-port dimensions, and steam passages, as all of them entail drops in pressure, depending upon the speed. These laws are also very intricate and do not easily lend themselves to mathematical expression; and when formulas are used, they must also be corrected by test data, which of course are only approximate.

The second method, which is an outcome of just this consideration, was suggested also years ago by locomotive investigators. The advantage of the empirical method, expressed either by tables or formulas, lies in the idea of basing the calculations on horsepower rather than on tractive force, as the former depends upon a smaller number of variables than the latter. If the locomotive is built in accordance with certain standards of perfection and refinement, the horsepower depends mainly upon the amount of steam generated by the boiler. The sizes of cylinders do not come directly into consideration. If they vary within a limited range, as is the case in locomotives, and if the proportions are correct, they should not influence the steam consumption

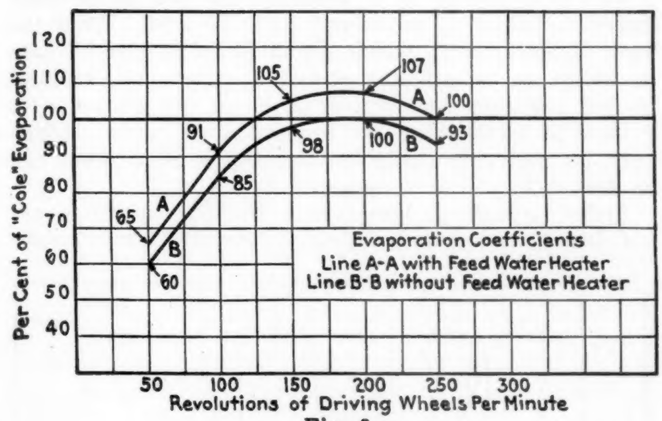


Fig. 3

per hp.-hr. As is known from the theory of steam engines, the important factors are the cut-off and the number of revolutions per minute. The first factor determines the expansion ratio and the thermodynamic efficiency of the steam cycle, while the second affects the condensation and steam-friction losses.

Some investigators think that steam consumption depends on piston speed, and so Mr. Cole found in his investigation of locomotive data, but the majority of steam-engine authorities refer steam losses to the rotary speed of the crank and not to piston speed. Steam-consumption figures based on recent locomotive test data also show more uniformity when they are referred to crank speed rather than to piston speed.

However the case may be, the advantages of referring the steam consumption to piston speed, or to the r.p.m., cannot be great, as the piston strokes do not differ much in modern locomotives, being between 28 in. and 32 in. On the other hand, as the cut-off depends on the r.p.m. and not the piston speed, it seems to be more practicable to consider the steam rate as depending on the r.p.m

The tractive force of a locomotive is one of the two components of the locomotive horsepower. The cylinders and driving wheels permit resolving the horsepower into tractive force and speed in accordance with

$$P = T \times V/375. \quad \ldots\ldots\ldots [5]^2$$

Thus the tractive-force calculations can be simplfied by determining first the locomotive horsepower as a function of either the r.p.m. or the piston speed, depending upon which of the two influences on the efficiency of the locomotive is reflected in the steam consumption per hp-hr., and then later resolving the horsepower into tractive force and locomotive speed.

The foregoing, of course, refers to the boiler tractive-

[2] Although some of the formulae have been omitted, the author's numbering has been retained.—Editor.

force curve, which has a hyperbolic shape. As to the horizontal portion of the tractive-force curve, this is determined entirely by the rated tractive force. There is no connection between these two except only as far as the sizes of the cylinders and boiler in a well-proportioned locomotive are dependent upon each other.

Boiler Tractive Force

Thus the tractive-force curve depends in its major part upon the amount of steam generated in the boiler and the consumption of steam per horsepower-hour. The natural thing, therefore, is to establish the laws of the two variables. The analytical method can hardly lead us to the result sought for, and we have to rely entirely upon test figures.

Unfortunately, tests are not being conducted in such a way as to enable us to establish the two above-mentioned variables as completely as is desired. Even the most elaborate tests, which are supposed to give all data in which an investigator should be interested, attempt to find solutions for various problems not always with a view to establishing the tractive-force curve. However, by analyzing available data, certain conclusions can be drawn, as will be seen below.

Strictly speaking, horsepower and tractive force are not definite conceptions unless we specify certain condi-

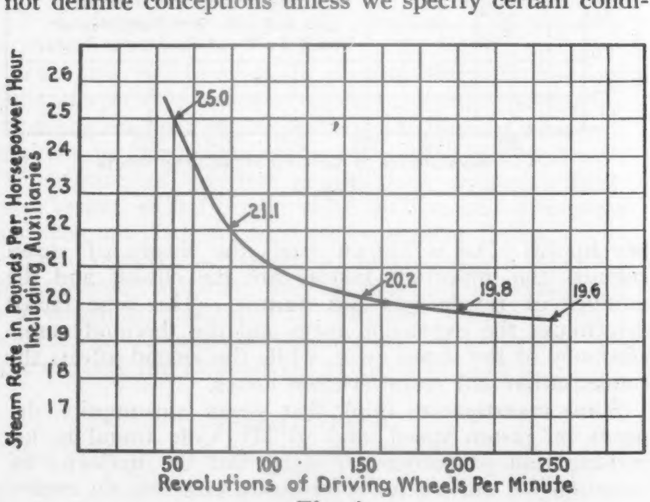


Fig. 4

tions at which power and tractive force are being considered. There can be the *maximum* tractive force which the engine is capable of producing irrespective of the amount of coal burned and the cost of such a forced operation. There can be the *most economical* tractive force, and this from the point of view of fuel only, when short cut-offs and long expansions are used, or from the point of view of total operation expenses. The latter is the more important, and it is safe to assume that under ordinary conditions the mode of operation of locomotives, established by long experience, is in the end the most economical. This can be called "performance tractive effort." Only in exceptional cases, when the locomotive is pulling a fast passenger train at top speeds and is forced to the limit of its power, is the maximum tractive force, or what is called the "capacity tractive force," developed.

The method of plotting the maximum and average performance curves is clear from Fig. 15. Both horsepower and tractive-force test figures have been used and mutually checked by Formula [5].

It would seem that stationary tests should give the figures of maximum evaporation and speed, because each test is conducted at constant cut-off and constant speed, and the most severe combination of these two variables should be close to the limit of boiler capacity. With this in view, curves were plotted for five Pennsylvania locomotives (K4s, E6s, K2sa, L1s and I1s), as shown in Fig. 1, for different numbers of revolutions of the driving wheels per minute. The data were taken from bulletins published by the Pennsylvania Railroad on locomotive tests at the Altoona testing plant. For better comparison, evaporation is given not in absolute figures but in percentages of evaporation for respective boilers in accordance with Cole constants (A. L. Co. Hand-Book, 1917, p. 59).

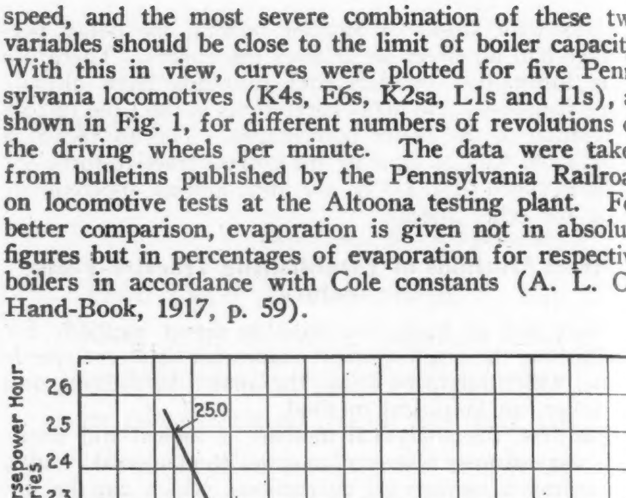


Fig. 5

It will be seen that while the curves differ very widely, their shapes all have the same parabolic characteristic of increase with speed up to a certain limit, and subsequent drop for higher speeds. The peak points are from 12 to 28 per cent above the Cole figure. This must have been due to forcing the boilers to high evaporation rates. The peak point on curve 1 (locomotive K4s), for instance, corresponds to a rate of firing of 171 lb. of coal per sq. ft. of grate area per hr. On curve 5 (locomotive I1s) the rate of firing is still higher, due to the small grate area of this locomotive. In Fig. 1 the rates of firing for peak points are inscribed in rectangles. The figures in circles represent the ratios of heating surface to grate area for each of the five locomotives. In other cases they have also been very high, indicating that Cole's evaporation corresponds very closely to a rate of firing of 120 lb. per sq. ft. of grate area per hr., as was assumed by him.

The shape of the curves evidently depends upon the ratios between the principal dimensions of the boilers. It is not possible to find a formula for the curves of evaporation as functions of these variables. They do not run consistently enough, and there are other variables that cannot be put in a formula, as, for instance, the quality of coal. More consistent results were obtained from plotting curves of road tests, as shown in Fig. 2. Three locomotives are considered here (New York Central J-1a and L-2, and Boston & Albany A-1), representing three different classes of service: High-speed passenger, high-speed freight, and moderate-speed freight.

As stated above, there are no test data which would permit plotting these curves directly. An indirect method was therefore evolved for this purpose. From road tests with locomotives the maximum-performance indicated horsepowers and corresponding speeds and cut-offs were chosen. From the Altoona tests, locomotives of similar engine size were selected, and the

steam consumption per horsepower was found. It was corrected for difference in boiler pressures and superheats, and further, a certain percentage for auxiliaries was added from road-test data. Thus the probable specific consumption of road locomotives per indicated horsepower at various speeds was established. The product of horsepower and the established specific steam consumption furnished a means of finding the probable steam evaporation of the road locomotive for the maximum-performance power.

It will be seen that in this case the variation of the maximum evaporation of different locomotives is much less; it is between 2.7 and 6.7 per cent greater than the Cole figure. The variation in the location of the peak points in relation to speed is also less, and they all happen to be between 150 and 170 r.p.m. Nevertheless, even in this case it was not possible to tie up the shape of the curves with the principal dimensions of the corresponding locomotives by a mathematical formula.

Other locomotives were also studied, and on the basis of the accumulated information it was found possible to draw a probable curve of evaporation, as shown in Fig. 3. It has a peak point 7 per cent above that of the Cole figure, and at about 200 r.p.m.

All locomotives shown in Fig. 2 were equipped with feedwater heaters, and it is very striking to find that the average maximum evaporation is about 7 per cent above the Cole figure. This is easily explained by the increase in efficiency due to feedwater heating. In other words, we may assume that the Cole evaporation figures still hold good for boilers on modern locomotives without feedwater heaters, but when locomotives are equipped with feedwater heaters, the boilers generate 7 per cent more steam.

It will be seen that the curve was plotted rather conservatively; at low speeds it follows the lowest portions of curves from road tests, while at high speeds it is slightly above the average for road tests—this for the reason that other locomotive data with feedwater heaters pointed in this direction. The plotting of this curve can be done by using the following formula:

$$E = \beta E_c \qquad [7]$$

where E = boiler evaporation at a certain speed
E_c = Cole evaporation figure
β = evaporation coefficient in relation to the Cole evaporation figure.

The evaporation coefficients are shown in Fig. 3 and repeated in Table I in relation to the crank speed.

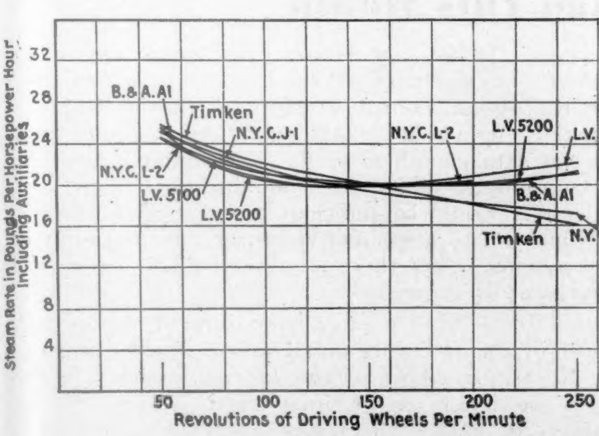


Fig. 6

It may appear that the average curve was plotted rather arbitrarily, and that another curve could be chosen for the average evaporation with equal justification. It will be seen later that the ultimate recommendations for plotting horsepower and tractive-force curves are based on test results and do not depend directly on the evaporation coefficients. They are independent of the evaporation curve plotted in Fig. 3, which is given here simply as an illustration of the principle of the method.

Table I—Evaporation Coefficients

Speed r.p.m.	Evaporation coefficient: Locomotives without feed-water heater	Locomotives with feed-water heater
50	0.60	0.65
100	0.85	0.91
150	0.98	1.05
200	1.00	1.07
250	0.93	1.00

Recommended Method

When the boiler evaporation is determined, the indicated boiler horsepower can be found from the Formula [6]:

$$P_i = \frac{E(1 - x)}{S_h} \qquad [6]$$

where E = evaporation, lb. per hr.
x = ratio of steam used for auxiliaries
S_h = steam consumption per horsepower-hour, lb. (steam rate)

provided S_h is known.

It was thought more advisable to study $S_h/(1 - x)$, which represents S_a, the steam consumption per horsepower-hour, including auxiliaries, rather than S_h and x separately. Various locomotives were analyzed and it was found that the average steam consumption per horsepower-hour, including auxiliaries, can be well represented by one of the two curves shown in Figs. 4 and 5, depending upon whether we refer them to the r.p.m. or to the piston speeds.

It can be seen that the two curves differ very little; in other words, the piston speed has actually very little effect on fuel consumption within the limits of strokes in modern locomotives, namely, 28 to 32 in. It is therefore practically of little importance for the computation of boiler horsepower whether the steam rate is taken as a function of crank speed or piston speed, at least for strokes between 28 in. and 32 in.

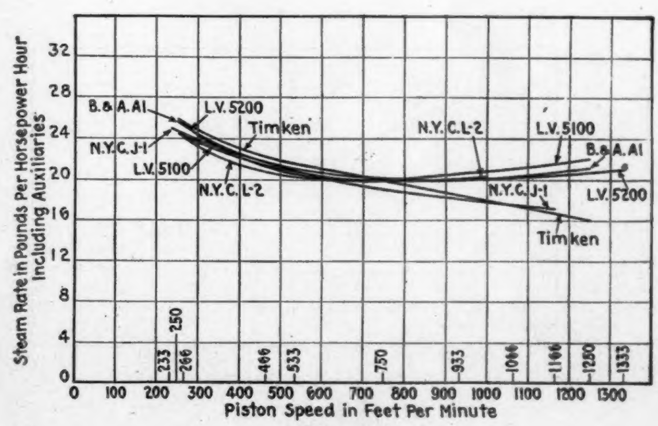


Fig. 7

The method of figuring boiler horsepower can thus be reduced to the following:

On the basis of general boiler dimensions the Cole evaporation E_c is figured and the various evaporations E for different crank speeds n (r.p.m.) are calculated in accordance with Formula [7] and Table I. The figures thus obtained for E are divided over the corresponding steam rates S_a of Fig. 4 and the quotients obtained are horsepowers P_i for the various speeds.

If it is desired to use Fig. 5, which gives steam rates with respect to piston speeds, then it is necessary that the evaporation figures estimated in accordance with Formula [7] and Table I be referred to piston speeds, which can be calculated for various crank speeds n by the formula

$$S_p = \frac{s \times n}{6} \quad \text{[8]}$$

where S_p = piston speed, ft. per min.
s = stroke, in.

In either case, whether the horsepower has been figured in relation to crank speed or piston speed, in order to find the tractive force it is necessary to refer horsepower to locomotive speed, which can be done by using the formula

$$V = \frac{D \times n}{336.134} \quad \text{[9]}$$

The tractive effort is easily calculated by using Formula [5].

Thus the boiler tractive force is determined and can be plotted on a chart. The rated tractive force is then figured, plotted as a straight constant-force line on the same chart, and extended until it intersects the boiler tractive force. The point of intersection determines the speed at maximum tractive force.

Regarding steam-rate curves (Figs. 4 and 5), the following is to be said:

The test data were not sufficient for plotting through the whole range of speed. Only a portion of the curves, representing the most frequent average speeds of road tests, could be plotted. In order to cover the whole range of speed, an inverted method has been used; assuming that the coefficients of evaporation β as above given were correct, the total evaporations of several existing locomotives were calculated as functions of speed and divided over the corresponding horsepowers. The results for various curves are shown on Figs. 6 and 7 in

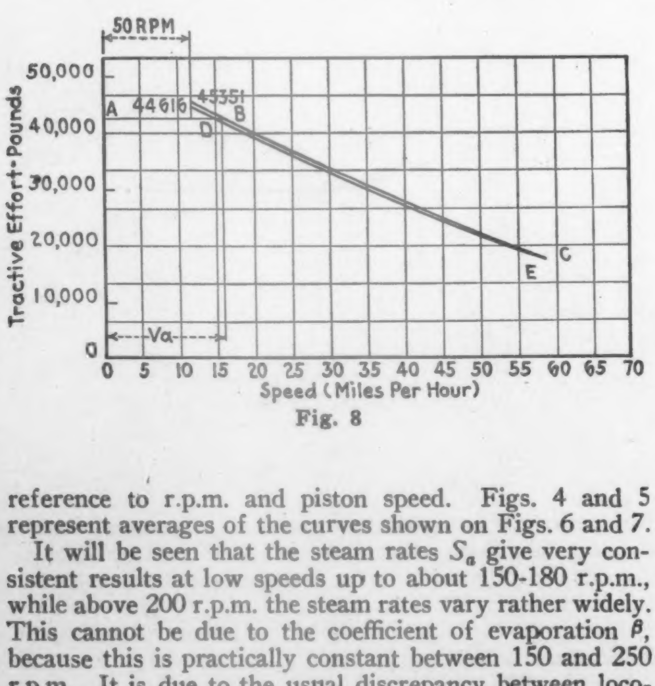


Fig. 8

reference to r.p.m. and piston speed. Figs. 4 and 5 represent averages of the curves shown on Figs. 6 and 7.

It will be seen that the steam rates S_a give very consistent results at low speeds up to about 150-180 r.p.m., while above 200 r.p.m. the steam rates vary rather widely. This cannot be due to the coefficient of evaporation β, because this is practically constant between 150 and 250 r.p.m. It is due to the usual discrepancy between locomotive-test results at high speeds, because the influence of such factors as quality of coal, size of nozzle, drafting arrangement, steam passages in the cylinders, and valve-motion design become more pronounced at higher speeds.

The average curves check fairly well with steam-consumption figures obtained from tests for the ranges of speed for which data are available. By correcting them back through the coefficient of evaporation and test results for horsepower, the influence of β is eliminated if the horsepower of an existing locomotive is calculated as suggested above, on the basis of β and of steam rate S_a corrected on the same basis. This will be made still clearer later, when the simplified method is described.

An example may better illustrate the method. Suppose that we wish to find the tractive-effort curve for a 4-6-4 locomotive with 25-in. by 28-in. cylinders, 225 lb. per sq. in. working pressure, 79-in. driving wheels, Type E superheater, feedwater heater and a boiler of given dimensions (New York Central J-la).

We determine first the Cole evaporation E_c in accordance with the A. L. Co. Handbook or calculate the evaporation by some other means—for instance, assuming an average evaporation of 12.2 lb. per sq. ft. of total evaporation heating surface. If we follow the A. L. Co. figures, we find that E = 54,662 lb. of steam per hour.

Suppose that we prefer to figure on the basis of steam rate in relation to piston speed rather than r.p.m. In this case draw up Table II on the basis of the curve, Fig. 5. Then plot the boiler tractive-force curve *DE* (Fig. 8). Calculate the cylinder (starting) tractive force and plot a horizontal line *AD* corresponding to the cylinder tractive force up to its intersection with the boiler tractive force. The line *ADE* represents the indicated tractive force of the locomotive calculated on the basis of piston speed.

If instead of Fig. 5, Fig. 4 were followed, i.e., with the steam rate referred to crank speed in r.p.m. instead of piston speed, the procedure would be simpler, because no conversion to piston speed would be necessary, as can be seen from Table III.

The results are plotted on Fig. 8 as curve *BC*, and *ABC* represents the indicated tractive force of the locomotive calculated on the basis of crank speed. It can be seen that the difference between curves *ABC* and *ADE* is very slight.

(*To be concluded*)

One Hundred Years Ago This Month

March 9, 1833.—The report of a committee to the president and directors of the Paterson and Hudson River Rail Road Company estimates the cost of two locomotive engines at $8,000, or $4,000 for each unit. Based on data contained in the sixth annual report of the Baltimore & Ohio, this committe ascertained that $16 per day would be sufficient to cover all of the expenses incident to a locomotive power. In this estimate of the moving power there is allowed $2.50 for repairs and renewal of engines.

March 16, 1833.—A letter from John B. Jervis, civil engineer of the Delaware and Hudson Canal Company, to D. K. Minor, editor of the *Journal*, appears in this issue. The letter was written from Albany, N. Y., February 26, 1833. Mr. Jervis described the construction and operation of the five ascending inclined planes between Carbondale, Pa., and the summit of the mountain. He also reported the result of 76 experiments made with sails designed to retard the descent of cars down inclined planes. The wagons used on the railroad of the Delaware and Hudson Canal Company had an empty weight of about 22 cwt. and carried 2½ tons of coal.

EDITORIALS

Boiler Explosions Still a Menace

Locomotive boiler explosions continue to constitute a railroad problem of major importance and a serious menace, as shown by the fact that in the past four years 82.5 per cent of all fatal accidents due to failures of locomotive appurtenances were caused by crown-sheet failures. While the total number of crown-sheet failures due to low water has shown a fairly consistent decrease from 92 in 1912 to 6 in 1932, as shown by the reports of the Interstate Commerce Commission, Bureau of Locomotive Inspection, the number of injuries and particularly the number of fatalities, incident to these failures, have not shown such a rapid proportionate decrease.

In fact, the percentage of all fatal accidents which caused by crown-sheet failures actually increased from 54.9 in 1912 to 88.8 in 1932, and the average number of men killed per crown-sheet failure for each previous four-year period increased from .438 in 1915 to 1.000 in 1932. This continued increase in the average number of men killed per crown-sheet failure is no doubt largely chargeable to the increased average size of boilers and the greater steam pressures carried, both of these factors tending to produce more violent explosions.

While every effort can and must be made to enforce instructions regarding the proper practices in the maintenance and operation of locomotive boilers, it is equally essential to utilize to the fullest extent those mechanical devices and appliances, the application of which to locomotive boilers has been shown by experience to guard against failure of the human element. Not only should such devices and appliances be installed, but due precautions should be taken to make sure that they are properly maintained. It is only by this means that the maximum results can be attained in further efforts to prevent the occurrence of boiler explosions which still take a heavy toll in personal injuries and fatalities, as well as by the destruction of railway property.

Paying More And Getting Less

There is a wide difference of opinion existing, even among cost accountants, as to the proper methods of determining the so-called "overhead costs" of manufacturing operations. As far as the railroad shop is concerned, even in normal times, the accounting set-ups for determining the costs of performing work are not as flexible and elaborate as those that are in effect in industrial establishments. Because of the fact that the product of a railroad shop—maintenance—is not something that must be taken out and sold in the face of competition there has never existed that pressure for an intimate knowledge of detail costs that obtains in industry. The conditions we are operating under today are bringing about the desirability of studying this subject a little more carefully.

No one will question the necessity of performing work as economically as possible and an important part of the shop supervisor's job for the past two or three years has been to scrutinize every operation with the object of cutting out the lost motion and stopping any leakage as far as expense is concerned. Yet, in many instances, there seems to be a tendency to be penny wise and pound foolish with respect to the practices that are being built up in many shops of using the urge for economy as an excuse for manufacturing and "reclaiming" many articles and parts that might more economically be purchased on the outside.

Under present cost accounting systems in effect in railroad shops it is an easy matter to get into the frame of mind whereby figures are accepted as conclusive without taking into consideration related facts that, when properly analyzed, would discount the accuracy of the figures. One basic fact should never be lost sight of as far as a railroad repair shop is concerned—that the real objective of the shop is to repair cars and locomotives. A realization of this fact will anticipate any attempted justification of the many extraneous operations and practices with which railroad shop supervisors often find themselves involved. Accepting such a fact, then, as a basis upon which to work, the major effort of a shop and its personnel should be devoted to the job of overhauling cars and locomotives in the least possible time and at the least possible expense consistent with satisfactory service after they are turned out. How, then, can many of the manufacturing and reclaiming practices in railroad shops today be justified? The logical question next to be asked is "What is wrong with our present cost system and how can the real costs be determined?"

When an attempt is made to determine the cost of manufacturing an article in a railroad shop for comparison with the cost of purchasing the same article in the open market the cost is usually based on the actual labor and material involved with a small additional stores and shop expense added to the direct material and labor costs. There are, however, other costs involved such as investment in plant and equipment, taxes, insurance, depreciation on plant and equipment, administration and superintendence, maintenance of plant and equipment and power. Some of these items are fixed charges while others vary within rather wide limits. In any event these "overhead" costs must be added to the direct and indirect labor and material charges and, in normal times, when applied to a large volume of output may be relatively small while in times such as the railroads are experiencing right now this overhead, applied to small quantity production runs up the total cost to a considerably larger figure than under former conditions. It will be argued that the facilities are available and might as well be used. The indisputable fact is that the railroads today have maintenance facilities for which they have no need and as long as these facilities remain a part of the property the fixed charges on the excess must be included in the cost of production. The existence of such excess capacity provides the temptation to find a way to utilize it by developing practices that may be economically unsound and, having utilized it by going into the manufacturing business on anything but a business basis, the improperly appraised results are used as an argument for continued expansion of the excess facilities.

Sooner or later the railroad industry will be confronted with a major problem in the necessity of reducing investment in maintenance facilities if for no other reason than

to save the charges against it. There is no need whatever to consider the question of scrapping facilities that have real operating value for, fortunately in this case, that portion of the railroad plant of today, which is actually no longer of value because of obsolescence, constitutes the logical point from which to start.

The immediate opportunity lies in the possibility of considering carefully the many manufacturing and reclaiming operations that have been developed as a means of utilizing excess capacity and determining whether or not it might not be the better part of wisdom, under present conditions, to purchase many repair parts from the supply manufacturers that specialize in their production. The railway supply industry has built up over a period of years a specialized plant and personnel that is well equipped to furnish the railroads with service and products of unquestionable quality and in going into manufacture and reclamation on the scale that some railroads have done is merely contributing to the ultimate drying-up of a source of supply that is going to be sorely needed when the tide of traffic turns the other way.

A Lesson Of The Depression

The decline of traffic and earnings and the necessity for increasingly drastic curtailment of expenses have been so much the center of attention in the railway industry during the past three years that the changes in the character of freight-train operation taking place during this period have attracted relatively little attention. These changes have been of a character to make much of the motive power now dignified by the classification "stored serviceable" both uneconomical and unsuitable for any further use.

The average speed of freight trains has been increasing steadily since 1923, the year-to-year increases up to 1929 varying from less than 1 per cent up to 5 per cent. The largest percentage increase in any one year occurred in 1931, in which year the average speed was 14.7 m.p.h., 6.5 per cent higher than in 1930. Although the effect of the depression on train loading had begun to be felt, the decrease in gross tons per train in 1931 as compared with 1930 was only about 2 per cent—not enough to account for the increased speed. A further increase of 5½ per cent from 1931 took place in 1932. In this case, however, the train load had dropped from 1,823 tons in 1931 to 1,690 tons in 1932, and the reduction in train load itself may have been responsible for a part of the increase in speed.

During the years since 1929 the average speed of freight trains has increased more than 17 per cent, and in 1931, when at the peak, the gross ton-miles per train-hour were nearly 10 per cent greater than they were in 1929.

This marked increase in freight-train speeds is one index of the effort the railroads are making to meet the demands of shippers and highway competition. It has been made possible during the years when the gross train loads were the largest in railroad history by an improvement in motive-power service. This improvement is less the result of recent purchases of new motive power than of the retirements of old motive power which have been decreasing the locomotive inventory during the past ten years and by the storage of unusually large numbers of the older locomotives and the operation of the railroads with their best motive power.

With service of a character which requires an average freight-train speed of over 15 miles an hour on all of the Class I railroads once established, it is scarcely conceivable that any appreciable reduction can be made in this average without jeopardizing the competitive position of the railroads. With an increase in traffic which will require the present stored power to be drawn upon, the ability of the railroads to continue operation at present average speeds will be increasingly jeopardized. Freight-train schedules in main-line service approaching passenger-train speeds, which have been responsible for the steadily increasing average, are beyond the physical ability of much of the motive power at present owned by the railroads. If the older locomotives are returned to service, not only will the service which they perform directly be slowed up, but the ability to utilize the capacity of modern motive power will also be destroyed. The retention of the obsolete locomotives will destroy the value of the modern.

Aside from its inability to meet the requirements of present-day freight service, much of the older motive power now owned by the railroads is becoming too expensive to maintain, when measured by the standards of economy now being established by modern locomotives. Recently built locomotives of high horsepower capacity are demonstrating their ability to run 100,000 to 125,000 miles between heavy class repairs. The mileage of much of the motive power from ten to twenty years old cannot be stretched to exceed 50,000 and 60,000 miles. The costliness of retaining obsolete motive power which jeopardizes the competitive position of the railroads thus becomes ever more apparent.

Once the trend of traffic becomes definitely established in an upward direction, the need for more locomotives which can meet the tests established by modern motive power will rapidly become acute. It is not too early to prepare to meet this situation now.

The Rehabilitation Of Freight Cars

As the result of an accumulation of deferred maintenance during the war the railroads undertook an extensive program of equipment rehabilitation following the shopmen's strike in 1922. This program, which was pushed vigorously in 1923 and 1924 with a large expenditure of labor and material, resulted in a steady decline of bad-order freight cars until 1928 and 1929 when the condition of equipment and the maintenance expenditures appeared to have reached a balance. During this period the effectiveness with which cars were used greatly increased and since 1925 the number of cars in service has declined, as has also the number of new cars purchased by the railroads.

In 1930 the railroads entered on another period of deferred maintenance. During the last three years the proportion of maintenance which has been taken care of currently has steadily declined and deferred maintenance has accumulated at a steadily increasing rate. In 1932 freight car-miles amounted to 40 per cent less than in 1929. The number of man hours applied to car repairs, however, had been reduced over 50 per cent and the purchase of materials by approximately 70 per cent in the same period.

But this is not all. A substantial part of the maintenance required by freight cars is the result of the action of "time and the elements." Indeed, the operation of this factor is likely to be accelerated during periods of light traffic and much equipment storage. Lack of paint,

for instance, is accelerating the destructive action of corrosion and decay.

As the time approaches when the demand for cars will increase, the railroads, therefore, will find themselves in much the same situation with respect to equipment conditions that they faced following the close of Railroad Administration operation. There is a new element in the present situation, however, which did not exist in that following the war. Improvements in design and rapidly changing service demands have now to be considered in determining how far to restore the equipment to normal serviceability by replacement and how far by repair.

For many years the trend in average weight and average capacity of freight cars has been steadily upward. In 1923 the average capacity of box cars was 38.8 tons. In 1931 this had increased to 41.9 tons. Similarly, the average capacity of all railway-owned freight cars had increased from 43.8 to 47 tons, and the average weight had increased from 20.7 to 22.5 tons within the same period. The average carload, however, which was 27.9 tons in 1923, has been below 27 tons in each year since 1927, amounting to 26.7 tons in 1930 and 25.9 in 1931. In 1923 the lading of the average carload represented 57.4 per cent of the gross load. In 1929, as the result of the declining load and the increasing car weight, the lading had declined to 55 per cent of the total weight and, in 1931, to 53.2. The net tons per train, which, in 1923, amounted to 46.2 per cent of the gross tons, had declined to 43 per cent in 1929 and to 40.5 per cent in 1931.

There is little reason to expect a return of conditions in the railway industry which will permit an increase in the average carload, unless it be by a progressive loss to competing agencies of traffic in merchandise and manufactures. The continued increase in average weight and capacity of railway equipment cannot, therefore, be justified.

Box cars are the class in which the increase in tonnage capacity and weight are contrary to the trend in the average carload. The need of new or modified forms of equipment to meet the requirements of much of the box-car traffic are becoming evident, but it is impossible to predict the extent to which they will replace the conventional box car. The latter is indispensable for grain and other carload commodities and will undoubtedly retain its position as the most important single type of freight rolling stock for commodities requiring weather protection.

Large numbers of box cars will be considered for retirement or rebuild repairs when an upward trend in car loadings has become definitely established. The new A. R. A. standard steel-sheathed box-car design for unrestricted interchange, in which a saving in weight of approximately three thousand pounds has been effected as compared with other designs of similar capacity, provides an opportunity to effect a worthwhile improvement in the weight ratio. The well-balanced design of this car also promises an improvement with respect to the cost of maintenance throughout its life.

Recent advances in truck design are the result of the first real effort ever made to improve the riding qualities of freight cars. One of the serious disabilities which the railroads face in competing with highway transportation is the rough handling to which freight on the railways is subjected. It is true that improved truck riding qualities are far from a complete solution of the problem of rough handling. They have, however, removed one source of damage to many types of commodities. In the case of open-top cars, there is the advent of the cast-steel underframe, with its possibilities for a maintenance-free life.

All of these and other factors tending to make present equipment obsolete must be taken into account in deciding the fate of the freight rolling stock which will come out of the depression in need of rebuilding or replacement. The vast improvement in the skill with which freight cars have been utilized during the past decade has placed a premium on cars of a high standard of serviceability. The opportunity to save excessive repairs and to improve serviceability which the new factors in equipment design offer will also make possible more intensive utilization and a smaller total investment.

NEW BOOKS

MECHANICAL WORLD YEAR BOOK. *Published by Emmott & Co., Ltd., King street, West, Manchester, England, 362 pages, 4½ by 6½ in. Price, 1/6 net.*

An entirely new section on Internal Combustion Engines is contained in this 1933 edition, having been made necessary by the rapid development of these engines, particularly the heavy-oil type, for both slow and high speeds, and the high-speed petrol engine. Another new section deals with bucket elevators, and the section on Power Transmission has been revised and extensively rewritten, with a note added on ball bearings for exceptionally high speeds. Further data on steel tubes is included in the section dealing with Pipes and Tubes, and the sections on steam turbines and boilers are supplemented with information on piping for the high temperatures and pressures now used, and data on the properties of steam within the same ranges.

OIL ENGINE TRACTION. *By Alan E. L. Chorlton, C.B.E., M.P., M.Inst.C.E., M.Inst.C.E., M.I.Mech.E. Delivered before the Royal Society of Arts, John street, Adelphia, London, W.C.2, England. 80 pages. Paper bound. Price, 3s.*

This paper, one of a series of Howard Lectures delivered before the Royal Society of Arts in March, 1932, deals only with the injection type of engine which uses relatively non-vaporizing fuel, the oil, in the form of a fine spray, being directly injected into the combustion chamber of the engine where ignition takes place automatically by the heat contained therein. The application of the oil engine to railways is first considered, then its application to road traction.

Part II discusses the development of the oil engine for purposes of traction, particularly on the road. It points out that most of the early applications of the internal-combustion engine to railway work made use of the gasoline engine in its existing form as used for automobiles, the locomotives so produced being of small size and type and generally employed for switching purposes.

Chapter III describes electric- and gear-transmission locomotives. Among these are the Lomonosoff for the Russian State Railways; the Beardmore-Westinghouse for the Canadian National; locomotives designed by Krupp; Sulzer-Diesel engines for the Buenos Aires and Great Southern Railway; locomotives built by Frichs, and Burmeister and Waine for the Danish State Railways; and the Brown-Boveri locomotive for Italy. Direct and mixed methods of transmission by gases are described in Chapter IV which concludes with a discussion of the use of oil engines in rail cars and short trains.

THE READER'S PAGE

An Old Timer's Valve-Setting System

TO THE EDITOR:

The article on valve changes by Harold Hopp in the December issue of the *Railway Mechanical Engineer* was very good. The sketches herewith show how I would read these valve stem marks. Fig. 1 is the same as Mr. Hopp's Fig. 1. Center the port lines for position *b*. Center the forward marks for position *d*. Center the back-up marks for position *a*. Center *a* and *d* for position *c*. The changes can now be measured directly without any figures excepting ratios.

It makes no difference whether the valve is inside or outside admission, unless a record is made of port openings, in which case it must be remembered that the front

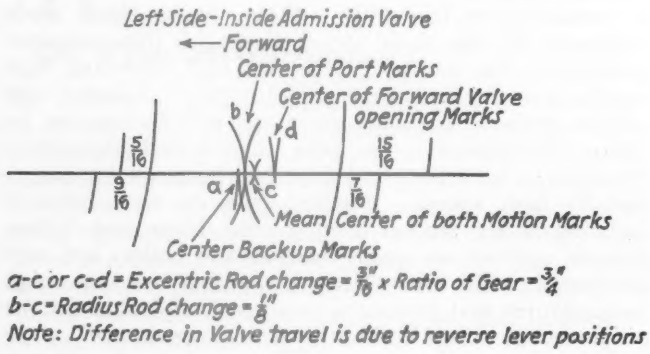


Fig. 1

port opening is shown by the rear marks with inside-admission valves.

When instructing apprentices, I used to teach them how to decide which way to make changes by moving the valve stem until the tram engaged the center marks of travel. When this position is obtained, it is very plain that the center of the port lines must move to the tram point.

See Fig. 1. Move the valve stem until position *d* is engaged by the tram, and notice how evident it is that position *c* must be moved back if the gear is direct motion. Then the eccentric rod must be shortened. Now engage position *c* with the tram and it can be seen at a glance that the radius rod must be shortened.

A rule I had was: "If the center of the travel is back of the center of the port lines, then the eccentric rod is shortened for direct motion and lengthened for indirect motion." The same rule applies to the radius rod.

Observe how centering the travel marks eliminates the necessity of considering difference of valve travel in the forward or back-up motion.

My Fig. 2 is the same as Mr. Hopp's Fig. 3. In this case position *c* is back of the forward travel center position *a*, therefore the eccentric rod change would be *a*, lengthened for direct motion.

In my Fig. 3 I show how the center of the travel marks coincide when the eccentric length is correct. If this point also coincides with center of the port lines, then the radius rod is also correct.

The whole problem can be stated in a few words by saying that the center of the port lines must be moved to the center of the travel marks. When this is understood, then the movement required can be seen at a glance at the engine.

I was required to set valves on a Southern valve gear without previous experience or information. I reasoned out the changes required and was surprised to find out later that my reasoning agreed with the recommended practices.

Some of the short cuts I have used are as follows: To ascertain the throw of a return crank for figuring

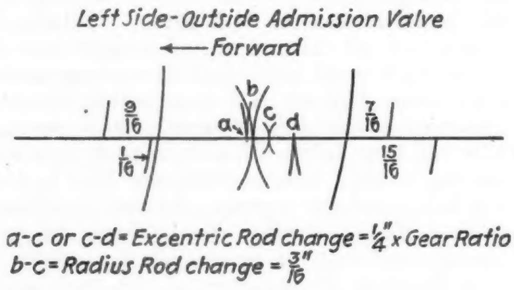


Fig. 2

ratio of eccentric rod to valve stem, use the figures on the inside of the long leg of a two-foot square for the crank-pin throw. Measure the length of the return crank on a diagonal to the inside edge of the short leg, and the figures on the short leg will tell what one half the return-crank throw is. The ratio thus obtained can be used for valve-stem marks made with the crank pin on dead centers, but is not accurate for valve-stem marks obtained by pulling the engine on account of link-block slips.

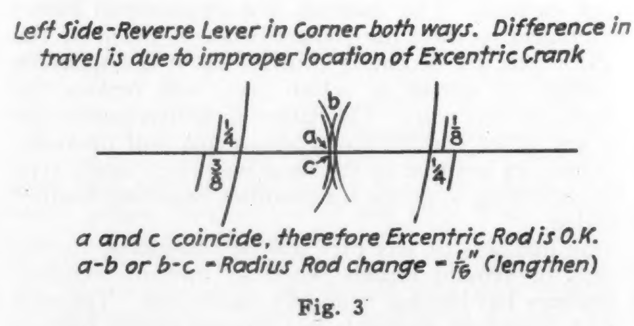


Fig. 3

When setting the valves with rollers, get the full travel marks and keep a record of the different center positions of full travel with dead-center travel. This will enable one to allow the difference when pulling an engine so the changes will square the valve the same as if dead centers were used. If this is done with each class of engine, then rechecking valve setting by full travel marks is practicable. Otherwise it is not.

Return-crank position can be checked by a tram from the center of the eccentric-rod pin to a position on the guide yoke. The distance should be the same on both dead centers.

Fig. 3 shows the return-crank location incorrect, as it shows an average of 3/16-in. lead ahead and an average of 5/16-in. lead backing. In this case place the engine on dead center; either one will do. Remove the key and bolt from the crank pin and move the return crank to

change the valve stem $\frac{1}{16}$ in. in the proper direction and the return crank is set ready to measure the offset of the new key and the reaming of the bolt hole.

It has been 20 years since I set a locomotive valve, but I still remember the required moves on account of developing the system of reading valve stems I have just described.

LINWOOD SKELLENGER.

Making Shop Grounds More Attractive

To THE EDITOR:

The Reader's Page in the January issue of the *Railway Mechanical Engineer* carried an account of beautification work on the grounds of shops, etc., of the Canadian National. Such work is to be highly commended. One sees a great deal of unsightliness these days about railroad shops and yards. Locomotives, cars and other equipment are stored, in many cases covered with rust, a condition which cannot always be avoided. A great deal can, however, be done in the way of general cleaning and picking up, including the disposal of materials which are or should be scrapped.

In one specific instance, the personnel of a large railroad took a great deal of pride in beautifying the grounds about the shops. This work was carried out exclusively during the noon hours; practically everyone would pitch in under the direction of one or more men who had knowledge of such matters at each shop point. At one large shop, a sizeable greenhouse was erected, employees furnishing the labor and the company furnishing the material. Employees and supervisors made contributions in diverse ways for plant material and, instead of an unsightly and hot cinder patch in front of and about the shops, there was growing a beautiful garden. It naturally follows that the general aspect of the grounds had its effect all through the shops.

In many cases, it would not be advisable to plant extensive flower gardens about grounds on railroad property, as, for example, in localities where a hot, dry climate prevails, or where soils and other conditions are unsuitable. Trees, shrubs and certain hardy grasses can, in many cases, be planted in open areas which take less constant care when once established. Certain evergreens, such as the spruces, are well suited for such work. These, of course, need not be of first quality as to form, but may be less costly. Several kinds of creepers are well adapted for covering slopes and banks and will relieve the unsightliness of the barren ground, choke weeds and cause less heat to be reflected from the ground. Flower beds can be introduced in prominent places. It is almost a necessity, however, to have a greenhouse for plant propagation. Such a house of moderate size can be built at very small expense. Most plants can be propagated from seeds at small expense. In some cases, an arrangement can be satisfactorily worked out whereby plant material is exchanged, employees furnishing plants for the grounds out of their surplus and receiving other kinds for their own use.

Time at the noon hour, or early morning hours in spring or summer, can be used profitably thus and the effect is worth many times the effort. Such work also has great educational value to the personnel. The railroad companies should not be adverse to a reasonable expenditure for this purpose, intelligently directed.

MECHANICAL ENGINEER.

The Power of Hand Brakes

To the Editor:

Calculating the power of hand brakes on page 24 of the January issue of the *Railway Mechanical Engineer* seems to be 50 per cent in error.

Instead of using the radius of the brake wheel times 125 lb., it should be the diameter of the brake wheel times 125 lb., equaling a 50 per cent greater chain pull when carried through to the hand-brake chain.

In support of this, let me refer you to A.R.A. Circular No. D.V. 255 published in tank-car specifications effective March 1, 1926.

CAR REPAIRER.

["Car Repairer" states the matter correctly. The use of 125 lb. as the amount of the force is based on the assumption that, in operating the brake wheel with both hands, a man can exert a force of 125 lb. on each side of the wheel.—*Editor*]

* * *

Foxburg, Pa., engine terminal of the Baltimore & Ohio

With the

Car Foremen and Inspectors

Cleaning and Deodorizing Hide Cars

THE importance of hide-car cleaning can be appreciated from the fact that a study made of the freight traffic on a large western railroad showed that, on an average, one loaded freight car of every 397 contained green hides. Cars thus contaminated can undoubtedly be restored to a first-class condition quicker and more economically by thoroughly cleaning and deodorizing them by the washing or similar method than in any other way.

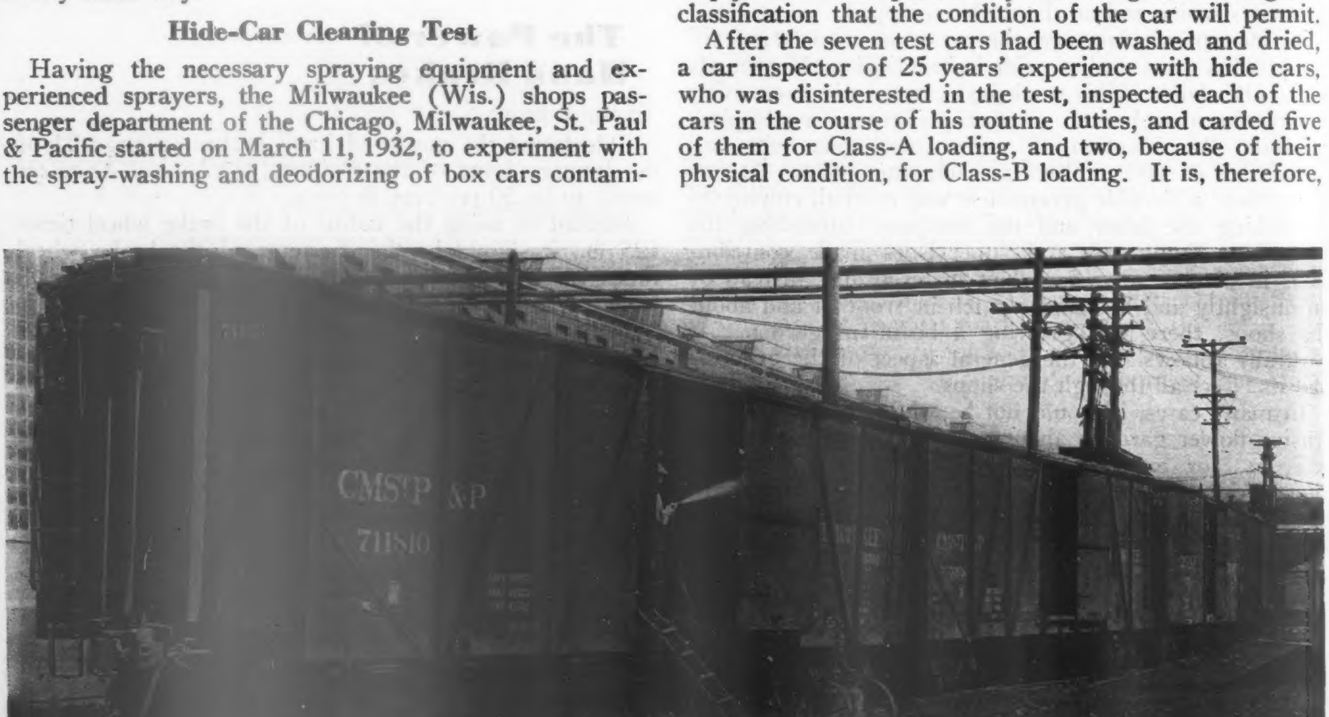
Hide-Car Cleaning Test

Having the necessary spraying equipment and experienced sprayers, the Milwaukee (Wis.) shops passenger department of the Chicago, Milwaukee, St. Paul & Pacific started on March 11, 1932, to experiment with the spray-washing and deodorizing of box cars contaminated by green hides which had been sent to the freight shop for repairs and cleaning. Between that date and June 20, fourteen hide cars had seemingly been successfully cleaned and deodorized in various tests. The same method and material were used in each test. A second complete test of hide-car cleaning was made on seven box cars in July and August, 1932.

The primary purpose of the July-August test was to determine whether or not the method and material used actually did clean and deodorize a hide car. The factor of costs was secondary. The test was carried to its proper conclusion by obtaining data on the first loading carried in each car after it was cleaned, and finding out whether any claims for damages to the lading had been made by the consignor or consignee.

To preserve the best box cars for the highest type loading, the Milwaukee has five classifications: Class A, box cars are fit for flour, cereal, paper, sugar, etc.; Class B, for bulk grain; Class C, for cement; Class D, general merchandise, etc.; and Class E, coal, hides, oil, paint, tar, machinery, grease and other similar commodities. In addition to other requirements, it is necessary that Class A, B, C and D cars be clean and free of contaminating odors. Class E, the rough freight cars, are all cars not meeting the requirements of Classes A, B, C and D. The carding instructions provide that after empty cars are inspected they shall be given the highest classification that the condition of the car will permit.

After the seven test cars had been washed and dried, a car inspector of 25 years' experience with hide cars, who was disinterested in the test, inspected each of the cars in the course of his routine duties, and carded five of them for Class-A loading, and two, because of their physical condition, for Class-B loading. It is, therefore, evident that insofar as inspection was concerned, the cleaning had raised the cars from the rough-freight (Class E) classification up to the highest class.



Four of the test cars set on the washing track for thorough cleaning and deodorizing after being loaded with green hides

After inspection, the cars were returned to service. The fact that they were test cars was kept secret, and their movement and loading was not guided or influenced. The cars were loaded with high-class freight (flour, bulk grain, etc.) at various stations, and no claims for damages were made by the consignors or consignees. Actual loading data are available as proof that the cars were successfully cleaned and deodorized.

Cost of the Cleaning Operation

The direct labor and material costs for cleaning and deodorizing the seven test cars varied from $5.93 to

$12.72, the average cost being $7.83 per car. Of this $7.83 cost, $1.76, or 22.5 per cent, was for labor, and $6.07, or 77.5 per cent, for material. The labor cost included both productive and non-productive time, and the material cost included the cleaning material, water, air and steam. No charge was made for switching service or overhead expense.

The labor cost of $1.76 included $1.30 for productive work and 46 cents for non-productive work. An analysis of these costs showed that at least 42 cents was unnecessarily spent because of incomplete facilities and experimental work. The performance of work in a routine manner with proper facilities would have reduced the labor cost to about $1.34 per car.

Of the $6.07 material charge per car, $5.79 was spent for cleaning compound and 28 cents for air, water and steam. No data were available as to the correct amount of cleaner and solution actually required for a hide car. Liberal quantities of material were, therefore, used in the test to avoid any charge, in case of a cleaning failure, that an insufficient amount of cleaner or solution had been used. Inasmuch as the cars were successfully cleaned, it is evident that no more material was needed than was used. On the other hand, there is no proof that the cars could not have been cleaned and deodorized equally as well by using a weaker solution and a reduced quantity of material.

The average cost of $7.83 per test car can, therefore, be considered a maximum cost which could have been reduced considerably in routine cleaning by employing complete cleaning facilities, and by having an exact knowledge of the amount of mixture and cleaning solution required.

No comparison is made in this study between the spray method of cleaning and deodorizing hide cars, as described herein, and other methods now in vogue, for the reason that specific cost figures, together with data on the quality of work performed under the other methods, were not available.

Spray-Washing Procedure

The seven test hide cars were cleaned and deodorized in the following manner: If not previously done, the floor of the car was swept with an ordinary broom to remove all rubbish, loose salt, etc. The hot cleaning solution was sprayed over the entire interior of the car. The spraying started from the bottom of the car and moved upwards, that is, first the entire floor was sprayed; second, the entire sides, ends, inside of doors, behind doors; last, the entire ceiling. This procedure gave the solution a chance to work longer on those parts of the car where the odor was greatest.

The hot solution was again sprayed over the entire interior of the car, following the method outlined. A hook scraper was pulled along in all the cracks possible between and in the floor boards, and especially along the line formed by the meeting of the floor and the sides and ends of the car. This scraping loosened and removed brine, dirt, etc., that was present in the cracks and allowed the solution to penetrate in the cracks. With a hand scraper, all paper, boards, heavy accumulations of dirt, etc., that were present on the sides, ends, doors, etc., were removed, as these obstructions often form pockets for dirt. Then, with car-cleaning brushes and ordinary brooms, the solution was brushed into the floor, sides, ends, ceiling, etc., especially where hide (white) spots showed.

The hot solution was again sprayed over the entire interior of the car. The entire interior of the car was thoroughly flushed with fresh, cold water. The nozzle of the water gun was held close to the floor, etc., to force all dirt out of the crevices. The flushing started from the top of the car and moved downwards; that is, first the entire ceiling was flushed; second, the entire sides, ends, inside of doors, behind doors; last, the entire floor. This procedure afforded more flushing for surfaces that were covered with the greatest amount of dirt and solution. The car was swept out with an ordinary broom or rubber scraper to remove surplus water, etc., off the floor.

The entire underside of the car was thoroughly rinsed with cold water. This included the underframe, trucks, bottom of floor boards, side sill or sheathing below the doorways, and any side or end sheathing where the water or solution had seeped through. This removed the solution, brine, dirt, etc., that dripped from the car body. The car was allowed to dry and air thoroughly, with the side doors opened, before being placed in service.

The DeVilbiss 30-gal. portable spray-washing equipment and water-rinsing hose used in cleaning and deodorizing the hide-car interiors

In the actual sequence of the cleaning operations on two cars, two men constituted the gang and used one set of washing equipment. The first man swept out, scraped and brushed one car, while the second man sprayed the solution. The first man then moved the spraying outfit and started work on the next car while the second man remained to water-flush the first. The two men thus worked together and independently in a progressive manner.

While the work was performed in accordance with this regular procedure, the scraping and brushing was intermingled with the spraying, and the removal of surplus water was intermingled with the water flushing. However, the scraping-brushing-spraying operations were completed before the car was water-flushed so as to permit the cleaning solution to work.

The main principle of the cleaning process is to allow the cleaning solution sufficient time to work or "eat in." The first tank of solution sprayed in a car worked on

the various cars anywhere from 79½ min. to 1,106 min. before any water flushing commenced. Also, the second tank of solution worked from 28½ min. to 98 min. before any water was applied in the car. The material was allowed to work without any loss of productive time on the part of the workman.

Material and Solution

The material used in the test was a cleaner and deodorant manufactured by the Sterling Chemical Company, Milwaukee, Wis., and known as their "Freight Car Cleaner—Formula J-H-J." This material is especially prepared to clean and deodorize, in one operation, cars that have been contaminated by green hides.

The cleaning solution used in the test was made by adding 1½ gal. of freight car cleaner to 30 gal. of hot water. To obtain the best results, the water must be hot, not warm, not boiling. The solution was then thoroughly mixed. The cleaner was also thoroughly agitated in its shipping container each time before any of it was drawn off for use. The solution was continually agitated while being sprayed.

No tests have yet been made to determine the exact number of gallons of solution required for cars of various degrees of filth, or the exact mixture of cleaner and water that will be most economical and successful. The cleaning of the seven test cars, however, showed that a mixture of 1½ gal. of cleaner to 30 gal. of water made an effectual solution. Also, the average car was successfully cleaned with 60 gal. of solution, while the filthier cars consumed 105 and 120 gal. The test indicates that the strength of the solution and the quantity required to clean a car is in the neighborhood of that used in the test.

The box-car cleaning was done on a short yard track having a capacity of four cars, and being easily accessible for switching. Air and water lines run parallel to the track and have outlets at convenient points. Hot water is obtained by means of a steam jacket, and straight steam is available by merely manipulating a valve.

The portable equipment used consisted of the following: One 30-gal. DeVilbiss portable car spray-washing outfit complete with an air-operated agitator, hose, nozzle, etc.; one water rinsing hose with an air-water type gun; a hook scraper 18 in. long and a hand scraper; ordinary brooms and a floor scraper with a rubber edge; one long- and one short-handled car-cleaning brush; two short ladders; tools and other equipment required to hook up the hose, fill the solution tank, etc.

Two types of solution spray guns were used in the test. While a cone-shaped spray with a low pressure thoroughly soaked the cars, a gun with a direct, straight stream of high pressure was found more satisfactory because it forced the solution into the cracks, and reduced the spraying time.

Drying and Ventilating

The seven test cars were held from three to ten days each, after being washed, to determine the rapidity of drying, the rapidity of the disappearance of odors, and whether or not the cars were successfully deodorized.

Five of the cars were dried and aired in the shop and yard, with their side doors opened and then closed. The other two cars remained in the yard with their doors continually opened. The data obtained in the test indicates that under typical weather conditions it required from 24 to 48 hours for a car to dry thoroughly after having been washed, and from three to four days for the odors to disappear, provided the car is held in the yard with its side doors opened.

The wetness found in the cars after 24 hours of drying consisted chiefly of moist spots on the floor at the extreme car ends. All the cars, after washing, possessed a slight odor. This odor seemed to be a combination of hide and cleaning material smell in which the sweetish cleaner smell predominated. This odor gradually became fainter and finally disappeared.

Attempts made to bring back the hide odor in five of the test cars failed. About five days after the cars had been washed, their side doors were closed for about three and a half days. When the doors were opened, there was a musty smell, the same as is present in any closed room, but no hide odor. This musty smell quickly left the cars after the doors were opened and the air circulated.

The rapidity with which the wetness and odors disappeared from the cars was largely dependent upon the prevailing weather conditions, inasmuch as only natural drying agencies were employed. The weather conditions during the period when the cars were being dried and aired could not be considered ideal, yet it was typical Milwaukee weather. The temperature averaged 72.7 deg. F., the humidity 66 per cent and the winds averaged 11.4 m.p.h. Drying will proceed most quickly when the temperature is high, humidity low, and there is sufficient wind to maintain a good circulation, say at least 15 m.p.h. Comparing the actual weather conditions with the ideal, meant that the drying conditions obtained for the cars were about 60 per cent perfect.

In the actual cleaning routine, it is only necessary to hold a car after washing until it is dry. When dry, any competent inspector can tell whether or not the car has been successfully deodorized.

Workmanship

The cars, after being washed, had a slight predominately clean smelling odor which gradually disappeared. The cleaner had a slight bleaching effect that left the cars clean looking, as well as clean smelling.

One of the complaints against using soda solutions of strength necessary to make a good cleaning job is that considerable of the water seeps through the wood of a car onto the steel and destroys the protective coating of paint, thereby allowing corrosion to set in. Undoubtedly, if the manufactured cleaner that was used in the test was applied "straight" or in very strong solutions and left to "eat" for any considerable length of time, it would destroy the paint on the car's underframe, etc. However, it is not necessary to use very strong solutions, and the cleaning method provides for thoroughly rinsing off the underframe, etc., with clear water. It is, therefore, safe to say that the manufactured material will have no injurious effects upon car parts. In one case, a tank of solution was sprayed in the car in the afternoon and left to work overnight. It was not flushed off until after another tank of solution had been sprayed in the car on the following morning. No injurious effects to the car were noticed.

MAYBE THIS IS THE ANSWER.—According to the Wall Street Journal, railroad grade crossings in Ireland are not the menace to motorists that they are over here. Every such crossing is guarded by a watchman throughout the daylight hours. At dark a large iron gate on each side of the railway is swung across the highway and padlocked. Pedestrians can get through without trouble, but vehicles cannot. Motorists traveling after dark must go to the watchman's house nearby, and get him to come out and unlock the gate before they can pass through. This system looks like the solution of several difficulties in this country. It ought to reduce or eliminate grade crossing accidents, and if the crossing watchmen were of the right type, it ought to tie up highway competition pretty effectively. By the right type of watchman, we mean one who never stays home at night.

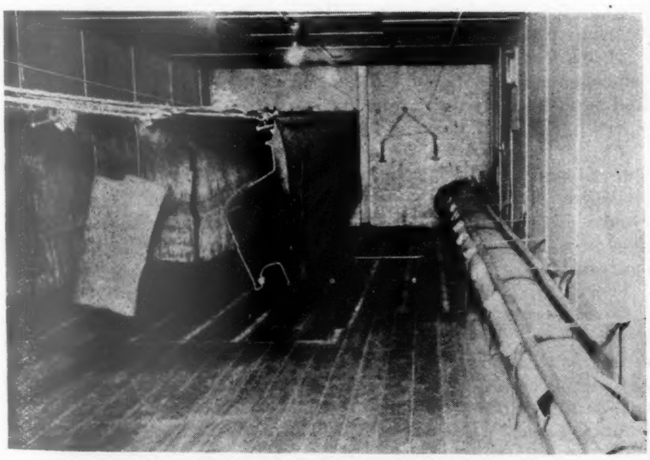
Carpet-Renovating Plant

As described in a recent issue of The Pullman News, The Pullman Company has evolved an inexpensive plant for the renovation of carpets that paid for itself in the first year of operation. The experiment which successfully operated in the Chicago districts of the Central Zone is now being used in other sections of the country.

The equipment is simple, consisting of a blowing platform, a scrubbing platform and electric-driven rotary brush for cleaning carpets, and an oven provided with equipment for quickly drying carpets without shrinkage.

When a dusty, dirty carpet is received from a car, it is laid on the floor of the blowing platform with the nap side up, and a perforated 3/8-in. pipe, connected by a hose from the shop air line, is thrust under it. The escape of the compressed air causes the carpet to vibrate and beat violently against the platform, dislodging the dust and grit from the base of the nap and bringing it to the surface, whence it is blown off by the air jet, or is removed by a suction tool. The carpet is now ready for a scrubbing of the greasy or stained nap, and is spread loosely on the scrubbing platform. The floor is slightly crowned in the center and has a draining gutter and splash board on each side, as shown in one of the illustrations.

A thick lather of suds is produced by the rotary electric brush as it moves over the carpet, a soap solution being fed through a small hose attached to the electric cord that supplies current to the brush. The thick suds hold all of the dirt on the surface, barely moistening the nap



Interior view of the drying oven, showing the steel carpet-supporting wires and one of the hot-air ducts. Air-heating furnace shown at the right

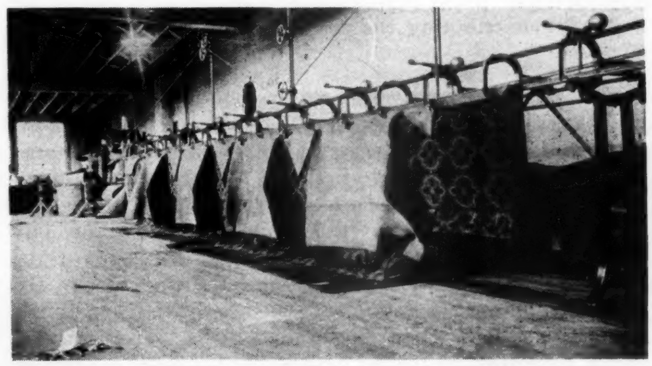
and not wetting the back. The suds are removed by a steel scraper and sponging the surface with clear water

The drying oven, in which the carpet is next placed, is a long tunnel supplied with hot, dry air for a thorough elimination of moisture. In order that the drying process may be complete, the carpets are suspended on pairs of steel wires, stretched from end to end of the oven, and supporting the center strip, as shown in another illustration. The carpet is fastened at one end by clamps in the wall and by clamps to a block and tackle at the other end, permitting it to be stretched and dried at its normal length. The carpet is dried in about one hour at a temperature not to exceed 140 deg. F.

In cleaning carpets by this method, approximately one hour is required for the blowing operation, using one man. Similarly, a carpet can be scrubbed by one man in one hour. In busy seasons, a two-man gang is used in scrubbing, one man operating the brush and the other scraping. The renovating process can be completed during the normal layover of a car. The removal of deeply-embedded dirt prolongs the life of the carpet, as grit cuts the nap at the base when walked on and causes threadbare spots. The cleaning process described restores the fluffy brightness of practically a new carpet.

Important Details of the Equipment

The space required for the scrubbing platform and oven is approximately 12 ft. by 60 ft. each. The scrubbing platform is made of 3/4-in. by 3 1/4-in. by 10-ft. matched flooring laid crosswise and crowned four inches higher at the center than at the sides to provide effective drainage. When originally laid, the flooring joints were painted with white lead. Subsequently, a coat of boiled oil has been applied every 60 days as a floor preservative to prevent the absorption of water and to make carpets slide more easily over the surface. The gutters of this platform are made of 6-in. half-round galvanized iron



Carpet-sewing machine which is a substantial time-saver over former hand-sewing methods

covered with a coating of asphaltum paint to assure long life.

The electric rotary brush is easily operated, the revolving brush being guided under its own power back and forth across the carpet by the skillful manipulation of the operating handle and with little manual effort. A unique feature of this rotary brush is the provision for supplying the proper amount of soap solution to the carpet as the brush is being operated. A small rubber-hose line supplies soap solution under air pressure from a suitable storage tank to the rotary brush handle, where it passes through a valve to a 1/4-in. copper pipe extending down the handle and fastened around the periphery of the brush housing. The lower part of this pipe is drilled with small holes to allow the soap solution to escape and drop as needed on the carpet. This construction is shown in one of the illustrations which indicates the convenient location of the soap-solution control valve with respect to the operating handle. Both the electric cable to the brush motor and the hose carrying the soap solution are long enough to reach the entire length of the scrubbing table, being carried by means of small pulleys on a supporting wire above the center line of the table.

The soap solution, which is delivered under 25-lb. air pressure to the scrubbing brush, is made by boiling 12 lb. of Ivory, or any equivalent, chipped soap in 5 gal. of water until the soap is thoroughly dissolved. The

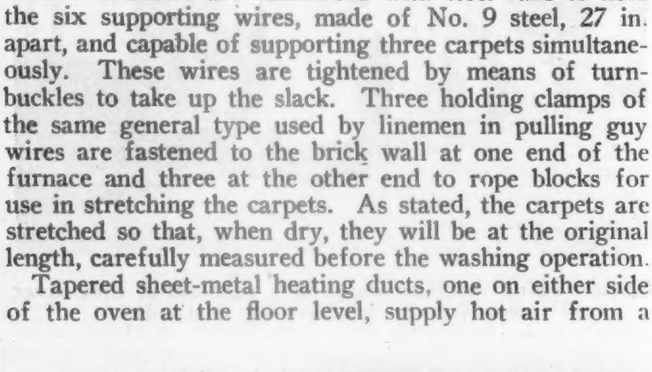
mixture is then diluted with 45 gal. of clear water and poured into the soap-solution tank, in which it is held under 25 lb. of air pressure. This soap-solution tank is located on the wall adjacent to the scrubbing platform.

The drying oven is 66 ft. long by 10 ft. wide by 7 ft. high, being made on the sides and top of gypsum board nailed to a 2-in. by 4-in. wooden frame. The brick ends

General view of the carpet-scrubbing platform and facilities for distributing the soap solution under pressure

of this structure are reinforced with steel rails to hold the six supporting wires, made of No. 9 steel, 27 in. apart, and capable of supporting three carpets simultaneously. These wires are tightened by means of turnbuckles to take up the slack. Three holding clamps of the same general type used by linemen in pulling guy wires are fastened to the brick wall at one end of the furnace and three at the other end to rope blocks for use in stretching the carpets. As stated, the carpets are stretched so that, when dry, they will be at the original length, carefully measured before the washing operation.

Tapered sheet-metal heating ducts, one on either side of the oven at the floor level, supply hot air from a



Electric-driven rotary scrubbing brush, equipped with a perforated pipe to distribute the soap solution

special furnace provided for this purpose. A 3-hp. motor, direct-connected to a 36-in. blower fan, is used to force air into this furnace and, after being heated, into the distributing air ducts. Thermometers are provided at each end and the middle of the heating oven, being readable from the outside through glass windows. A temperature of 110 to 120 deg. F. is usually maintained by proper regulation of the air furnace, special precautions being taken to guard against any temperatures in excess of 140 deg. F., which have a detrimental effect upon the wool in the carpet.

In addition to the cleaning operation described, carpet repairs are expedited at the Pullman shop by the use of seam sewing machines of the type shown in another illustration. This machine is particularly valuable in the making of new carpets and also when renewing middle strips. By means of the traveling head of the machine, a single seam of a carpet for a standard 12-section sleeper can be sewed in two minutes, exclusive of the clamping time, by a single operator, whereas hand sewing would require three women eight hours.

Common Conditions Causing Hot Boxes

*By P. P. Barthelemy**

This is the fourth instalment of a series of definitions of terms and conditions directly related to the hot-box problem. The third instalment appeared in the January, 1933, issue of the *Railway Mechanical Engineer,* page 25.

Wheel wearing to unequal circumference—On rolled-steel wheels this condition is frequently due to the difference in the shape of the tool used on mate wheels, one plowing deep grooves and the other comparatively shallow grooves. The wheels, when completed, will check to equal circumference, but as soon as they have run a while the one with the deep grooves will wear more rapidly and will soon be smaller than the mate, causing a lateral crowding, as mentioned above. A full-faced smoothing tool should be used on the finishing cut.

Trucks out of tram—That is, some of the vital parts being out of alinement.

Pedestals out of alinement—May prevent proper seating of the bearing. May also cause excessive collar friction.

Worn pedestals—This permits a partial locking of the box, which causes a jerky up-and-down movement between the box and pedestal. Also the rocking of the box in the pedestal produces a distorted bearing face in the babbitt lining.

Rough track—This causes excessive pounding between the journal and bearing. May also induce waste grab.

Center plate—A rough bearing surface on the center plates results in excessive center-plate friction, which tends to keep the truck from curving easily and properly, producing collar thrust and disalinement between the bearing and journal.

Center plate fit—Plates out of round or of improper size may lock together, the effect of which would be similar to that noted above.

Side bearing—Improper clearance, causing an excessive pounding motion when the car swings. Excessive friction between side bearings interferes with the proper curving of the truck, producing undesirable lateral thrust and disalinement of the bearings.

Sprung arch bars or side frames—Causing a disalinement of the journal boxes and other important parts.

Overload—An overload is likely to cause a break in the oil film between the bearing and journal and start a hot box. May also cause a bent axle or sprung journal.

High load—A load having a high center of gravity, which under certain conditions tends to rock considerably, produces a pounding action and a pounding thrust against the collar.

Cars loaded unevenly—Load much heavier on one side than on the other, which may cause the car body to rest on the side bearings. Excessive collar thrust, pounding, etc. may result.

Insufficient vertical coupler clearance—When going over rough track couplers on adjacent cars are liable to be locked and frequently an excessive downward thrust is applied to one of the couplers, resulting in temporary overload on that end of the car.

Insufficient side clearance for couplers—This causes excessive collar thrust when a car rounds curves, enters switches, etc.

Brake application—Particularly when rather violent, disturbs

*Assistant master car builder, Great Northern, St. Paul, Minn.

the position of the bearing and wedge, and is liable to cause a hot box. May also cause a waste grab.

Unequal braking power—With cars in a train having unequal braking power the one with the greater braking power is doing the most work. In other words, it tends to pull back on the car ahead and the movement on the bearing is much wider than it would be under ordinary conditions. This tends to distort the bearing face and may also induce a grab.

Lurch in train—Slack running in or running out produces a lurch that may cause a momentary raising of the bearing, thus possibly producing a grab.

Track curvature—This tends to contribute to the producing of hot boxes on account of the resultant abnormal collar thrust, unbalanced load, etc.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Discrepancies in Journal Dimensions

On August 27, 1930, the C. R. I. & P. applied wheels and axle to N.A.T.X. car 15161 which on January 3, 1931, were removed by the C. B. & Q., the latter road having turned the axle to remove bad fillets and then scrapped it because of small journal diameter, billing the car owner $8.39 for a second-hand axle applied in its place. Dimensions of the axle as applied by the C. R. I. & P. and as removed by the C. B. & Q. were submitted, but the car owner did not feel that both records could be correct and declined to assume the cost of the axle. The North American Car Corporation requested counterbilling authority from the C. R. I. & P. for $8.39 to cover the charge for the axle by the C. B. & Q. and, upon the refusal of the latter road, modified the claim to one-half the amount. While the billing repair card of the C. B. & Q. showed that the journal diameter of the axle, upon removal, was within the limits for a second-hand axle the C. R. I. & P. contended that "Bad-order fillets" did not explain definitely the particular defects which required the turning and contended that no adjustment should be required of it inasmuch as no evidence had been submitted to show that the axle, when applied, did not conform to the requirements for second-hand axles. The dimensions of the axle journal as submitted by the applying and removing roads showed a difference of ¼ in. diameter which difference the car owner contended could not have been the result of normal wear. The C. B. & Q. contended that this question was not involved and that it was necessary for them to take off $\frac{1}{16}$ in. from the journal to remove bad fillets which then made it necessary to scrap the axle. The car owners later modified its claim by a request that the adjustment be made on a fifty-fifty basis, each road involved assuming $4.20 of the cost, and in their statement contended that it was evident that some error had been made in reporting the axle diameters.

The Arbitration Committee, on November 4, 1932, rendered the following decision: "Arbitrary adjustment by each road making repairs assuming 50 per cent of the expense does not apply in the case of variance of dimensions of journal diameters. Interpretation No. 12 of Rule 98 clearly covers this feature. Car owner is responsible. (Note: The Committee believes responsibility in cases of discrepancies in all axle dimensions subject to wear should be placed in the same category as journal length, and will recommend modification of the rule to this effect in its next report)"—*Case No. 1703, Chicago, Rock Island & Pacific and Chicago, Burlington & Quincy vs. North American Car Corporation.*

Second-hand Brake Beams Claimed Defective When Applied

The Missouri Pacific made repairs and the car owner executed joint evidence cards at Kansas City, Mo., on Rock Island cars 41690, 152247, 39414 and 43756 covering the application of second-hand brake beams which were claimed to have been defective when applied. A request was made by the Rock Island for defect cards to cover and the Missouri Pacific refused to recognize these claims, stating as their reason that joint-evidence cards cannot be used to substantiate such claims. It was the contention of the Rock Island that defect cards were due on these cars because of the fact that defective brake beams were applied and charges were made for serviceable brake beams. It was the contention of the Missouri Pacific that it applied second-hand A. R. A. standard brake beams that were in first-class condition at the time of application. The joint evidence cards were signed by the assistant chief interchange inspector and the Missouri Pacific contended that if there was anything wrong with the brake beams the proper thing for the Rock Island car foreman to have done, would have been to call on the Missouri Pacific car foreman and let him have an opportunity to inspect them. Furthermore it was contended that the brake beams were not defective in any respect at the time of application and as the committee has ruled that joint evidence cannot be used to substantiate claims of this description, they are also invalid under Interpretation 3 to Rule 43 and Arbitration Decision 1651.

The Arbitration Committee, in a decision rendered November 4, 1932, said that "Rule 12 does not authorize the use of joint evidence cards to determine whether serviceable second-hand material was applied and as a definite statement has been made by the repairing road that the material was in first-class condition at the time of application, the contention of the Chicago, Rock Island and Pacific is not sustained."—*Case No. 1705, Chicago, Rock Island & Pacific vs. Missouri Pacific.*

Counterbore For Deep Holes

To bore deep holes, the O. K. Tool Company, Inc., Shelton, Conn., has developed a two-bladed counterbore. The ordinary multi-bladed boring tool, while ideal for shallow operations or where a small amount is left for finishing, is unsuitable for break-down or roughing operations.

When a hole is of some length and considerable metal is removed the construction as shown must be used. Two adjustable O. K. cutter blades are inserted into a forged and heat-treated alloy-steel body. They interlock with a pilot, which guides the tool through the bore. The body is cut away so that the chips have easy access to the opening of the hole.

Tools between 1½ in. and 6 in. diameter are manufactured. Cutter blades of drop-forged high-speed steel, super-cobalt high-speed steel, J. Stellite, or cemented carbide are available.

In the
Back Shop and Enginehouse

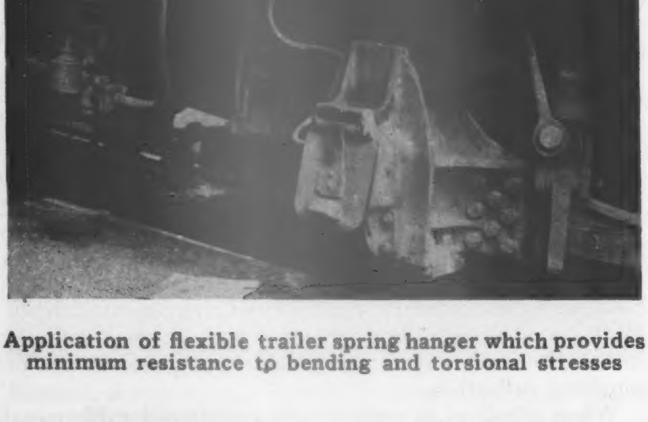
Extra-Flexible Spring Hanger

When business was good and locomotives were distributed with regard to design, very little difficulty of any consequence was experienced that did not reflect poor workmanship on the part of the maintenance and repair departments.

At the present time, however, when a great many engines are stored, some of which are of special design, there being also fewer types of engines in service, it is not unusual for failures to occur, unheard of heretofore. Sometimes these failures become a regular epidemic on one particular class of power, and they may be of such a nature as to cause one to wonder why such things did not occur before, since this type of power has been in constant service for a great many years. Therefore, under these circumstances, it is very hard to determine the exact cause and a possible remedy.

Until the time of the railway administration, a great many engines were equipped with trailer trucks which are known as the Hodges type. It is characteristic of this type of trailer truck that the lateral motion has to be taken in the rocking of the spring and hangers and that the lateral motion is also resisted by the trailing-truck centering device so as to bring the engine back in line as soon as a tangent track is reached.

On one road a great many locomotives equipped with

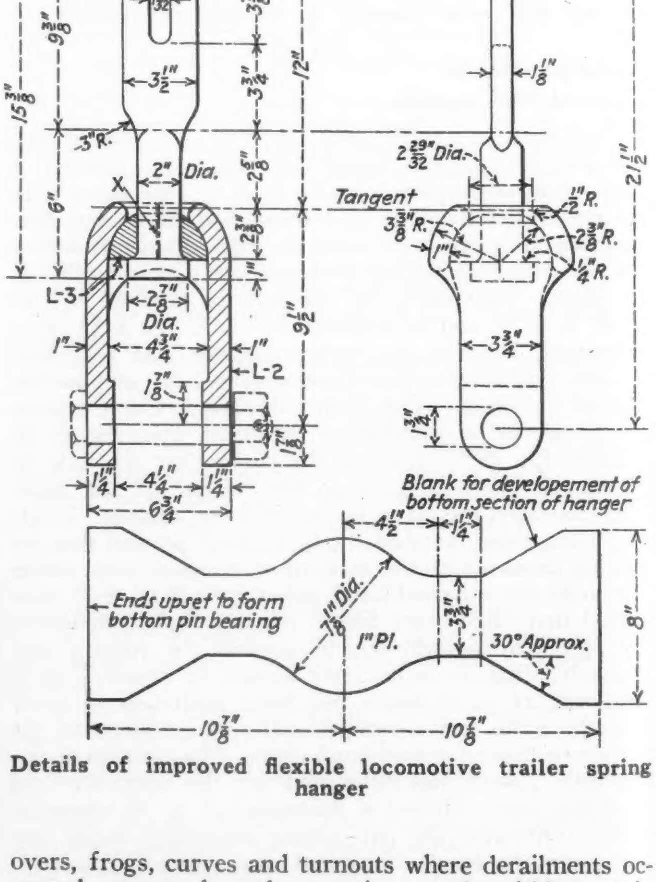


Application of flexible trailer spring hanger which provides minimum resistance to bending and torsional stresses

this type of trailer are in service, both Pacific and Mikado types. The heavy Mikado type to which this truck was applied has a long rigid wheel base of 16 ft. 9 in. These engines were designed for curves not in excess of 16 deg., and should not give any trouble when operated at moderate speeds on these curves, providing the wheels have the correct track play and box lateral and that the pony truck and trailer truck do not foul at any point within their lateral swing limits.

Because of new, heavier capacity designs of phosphate cars, it became necessary to operate these engines in a territory where the curves and turnouts were in excess of that for which the engines were designed. These engines proved of great value in the new territory, but they deteriorated more rapidly than in other territories and derailments became general.

A general study of all track, switch points, cross-



Details of improved flexible locomotive trailer spring hanger

overs, frogs, curves and turnouts where derailments occurred, was made and corrections made within certain limits. Then an engine was put through various curves and observations made. The first clue to the real trouble was given by the superintendent of motive power who observed that when it was necessary for the trailer frame to move in either direction, in most cases it could only do so by bending the hangers.

With this in mind, other tests were made and the results plotted for a maximum condition when the radius bar is at its limit off-center, left and right. The spring and hanger positions were also plotted, considering that they were free to move as intended. It was observed that the back hanger would have to swing 8 in. off-center, thereby lifting the back end through 3½ in. It was noticed also that it would be necessary for this hanger to make a twist of 1⅞ in.

Due to the extra flexibility of the forward hangers, the deviation from center, so far as swing is concerned, may be neglected. However, the twist is considerably more than is provided for, but part of the twist is taken care of by the connections.

To test out this theory, an engine was observed on a curve of varying intensity. It was observed that the back hanger travelled to a position off-center, at which point it appeared to be under considerable strain. In the meantime, the spring had rocked over hard against the vertical flange of the journal box and appeared to be in both transverse and torsional stress. The front hanger had not travelled so far from center, but all of its joints seemed to be hard in one direction, from torsional stress.

It was at this point that something happened. Upon entering the curve, the lead truck assumed the curve, but the front of the engine had continued in a straight line until it had absorbed all of the truck lateral, at which point it remained rigid until it had stressed the trailer hangers to the point, as mentioned. When the trailer truck entered the curve, it seemed to release the stress on the front end and allow it to swing to normal momentarily, and then it would swing back across the track. This swinging back and forth, or pinching around the curve, increased in intensity with the increase of the curvature until it became a bang at every swing. The engine truck (front), of course, absorbed the momentum of the front-end thrust by forcing the flange of the engine-truck wheel hard against the rail. If the condition of the flange and rail are good, this action causes the opposite wheel to rise approximately three inches above the track. But, if the top of the rail is worn, the leading active wheel flange assumes cam action and jumps upon the rail.

With this information at hand, it was decided that the trailer truck required more flexibility; therefore, a swivel-type flexible hanger was designed, as illustrated. Part *L-1* is a forging made of 2-in. round steel upset and machined as shown in the drawing at the lower end and flattened and slotted at the upper end to engage the trailer spring. The lower part of the hanger *L-2* is a steel forging developed from a flat blank one inch thick, cut to the shape shown. This blank is then heated and forced into a die, using a round steel punch under the steam hammer. The blank is then trimmed and lined up, drilling and filleting being done on the drill press. The maintenance of the ½-in. radius *R* is very important and should be made full rather than scant.

The forged insert *L-3* is made of tire steel sawed in two at *X* and the two halves sweated together. The forging is then machined to the shape indicated, the bottom faced off, a 2-in. hole drilled and a ¼-in. radius turned, as shown in the drawing. The forging is then heated until the two halves separate and the solder is filed until the two halves make a snug fit on the hanger.

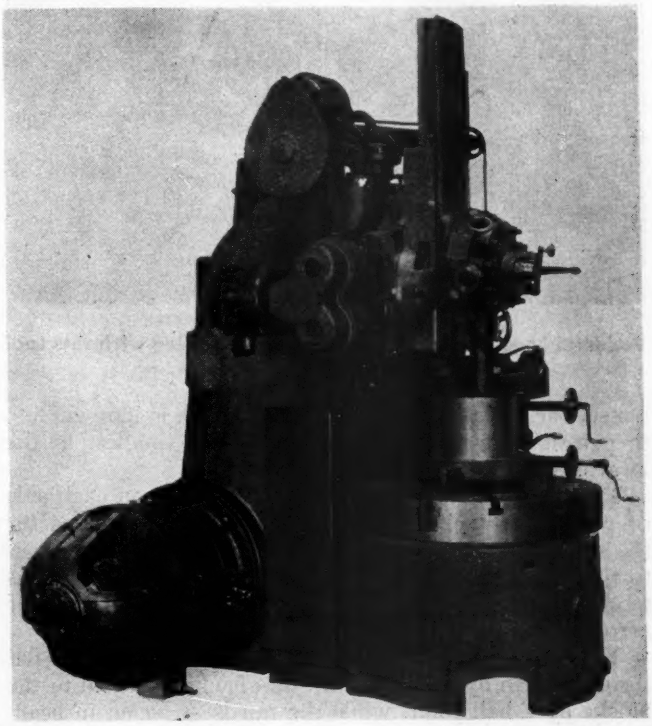
The Pacific-type engines, which are equipped with Hodges-type trailing trucks, do not derail as easily as the Mikado type, because of the relatively short wheel base. It was noticed by test that, when equipped with the swivel-type flexible hangers, the riding qualities are considerably improved and that they will take sharp curves with greater ease and with less disturbance to the spring rigging.

SAFETY RECORD.—Apparently, they believe thoroughly in "safety first" on the Kansas City Southern. According to reports from the mechanical department at Texarkana, Ark., it has been more than six years since a reportable personal injury occurred there. Incidentally, Texarkana yard engines have accumulated 237,923 miles of service since the last engine failure there which occurred on August 1, 1927.

Motorized Vertical Turret Lathes

THE Bullard Company, Bridgeport, Conn., has recently brought out a line of vertical turret lathes which are completely motorized with the idea of adapting them primarily to high-speed work. These machines make it possible to take full advantage of the use of metalloid cutting tools and, as an example, in the case of the 42-in. machine, it is possible to obtain table speeds ranging from 4.1 to 150 r. p. m.

The illustration shows a Bullard vertical turret lathe with a flange mounted motor as well as the method of application of the power traverse and rail-raising motors. The power traverse, rail-raising mechanism and cutting lubricant system are each driven by individual motors. In addition, the lubricating system, by means of its own motor drive, provides pressure lubrication of filtered oil to the spindle bearings. The lubricating pump motor is inter-connected to the main drive control so that if for any reason the pump motor should cease to function, the main drive motor is automatically cut off the line.



Bullard motorized vertical turret lathe for high speed work

The main drive motor may be connected to the machine in any one of three ways: The flange mounting as shown; direct coupled with motor floor mounted; or through a chain or V-belt with the motor floor mounted or on a bracket at the rear of the machine.

Portable Pedestal Miller

By R. B. Loveland

THE chipping and filing of pedestal toes on locomotive frames, after they are built up with acetylene welding, is a slow and tedious job. For that reason, the

portable miller shown in the illustration was constructed for milling pedestal toes. This miller consists of two chairs which are bolted to the locomotive frame through the pedestal-cap bolt holes. To these chairs is bolted

Pedestal toes on any size frame can be milled with this tool

a steel bar 2 in. by 3½ in. by 50 in. which is long enough to permit adjustments for work on the smallest to the largest locomotives.

The head is made up of a soft steel block on each side of which are steel side members which act as guides for the yoke. In order to permit the milling of the frame toes to the correct angle, the side frames have been cut so as to allow them to swivel several degrees either side of zero.

The yoke, which is nicely fitted in these guides, is fed through them by a screw, one end of which is held to the blocks by a ball joint, while the nut is swiveled in bearings fastened to the yoke. The screw which serves as the feed is turned by a ratchet handle.

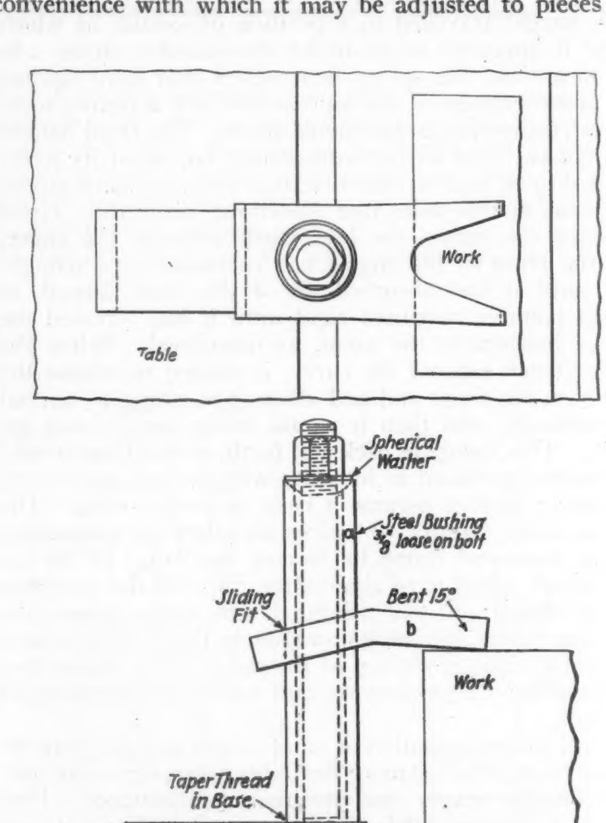
A bracket is arranged on one side of the yoke to accommodate the air motor by which the cutter is driven. Since it is an advantage to mill from the bottom up, a reversible motor is used, along with right- and left-hand cutters.

Universal Drill Press Clamp

A QUICKLY adjusted and substantial clamp, designed primarily for the drill press, but applicable to other machines having T-slots for bolts in the table, is illustrated in the accompanying drawings. The purpose of this clamp is to eliminate the large number of bolts, washers, and blockings necessary with ordinary U-clamps to accommodate work of different size and to provide a single clamp that will hold any work up to its capacity.

The principle of the fixture is apparent from the illustrations. The column *a* is long enough to accommodate the largest pieces ordinarily clamped. The sliding member *b*, which does the actual clamping, is slipped along the column and adjusted to the height of the work while the column is held up, giving clearance at point *x* between the clamp and the table. The clamp will hold itself in this position until the nut is tightened. Then the lug *c* will act as a fulcrum, and the column will lean slightly toward the work, causing the clamping member to grip the work firmly. Enough force may be applied to start to bend the clamping member.

The chief advantage of this clamp is the speed and convenience with which it may be adjusted to pieces of



Universal clamp for holding work on drill-press and other machine tables

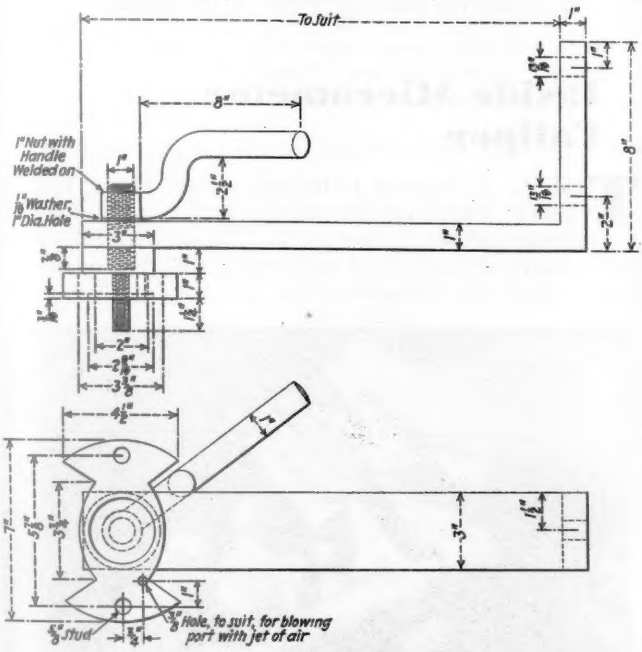
varying size. It is not difficult to make, as steel tubing suitable for the column will be found in every shop, and the other pieces may be cut or forged from flat stock. The sliding member is made a good fit on the column and, when the nut is tightened, it grips the column and will not slip. The column is threaded on the lower end and screwed into the base.

The First Head-On Collision.—Thanks to the courtesy of W. G. Besler, chairman of the board of the Central of New Jersey, who passed along a letter he received from Ivan Nicholson, furloughed employee of the Canadian National at Montreal, Que., we are privileged to repeat the story of the first head-on collision between steam locomotives which occurred in this country. Mr. Nicholson ran across the story while reading up on railroad history. It seems that the first head-on collision occurred on the Camden & Amboy, now part of the Pennsylvania, in 1836. In a thick fog, a train of lumber collided with a passenger train, producing what a newspaper of the day described as a "tremendous crash." Apparently, they did not run trains quite as fast in those days as they do now, since no one was seriously injured. The enginemen and firemen jumped off in time and the passengers went through the experience with only a few bruises here and there.

Distributing-Valve Repair Stand

IN railroad shops, various means of holding a distributing valve are employed while cleaning or repairing. One of the most common of these is to bolt the valve to the test rack and clean or repair it while on the rack. Other methods employ the use of some sort of a repair stand and these are usually of the stationary type.

The type of repair stand shown in the drawing illustrates the revolving-head type which is the most convenient repair stand obtainable for distributing-valve repair work. The valve is secured to the repair stand by means of two ⅝-in. studs. The revolving head, with the valve attached, can be moved to any position by releasing



A convenient and easily-made type of revolving-head distributing-valve stand

the tension on the one-inch clamping stud and nut and, when the desired position is obtained, it is clamped again. For grinding valves, the horizontal position is used and, for reclaiming scored cylinders, the vertical position is employed while using the hand cylinder grinder. The shape of the head is so designed that all ports can be easily blown out by a jet of air from the back of the valve, thus insuring the ports from being stopped up by foreign matter.

The repair-stand pedestal is made of 1-in. by 3-in. flat iron. The revolving head is made of steel and is turned up on the lathe. Afterwards, the face of the head is finished, as shown. The clamping-nut assembly is made of a one-inch nut with a piece of one-inch round iron welded to same.

This type of repair stand is easily made and is very convenient. It is a real asset to any air-brake repair room.

Inspecting and Reconditioning Leather Belts

*By J. N. Smith**

DURING the past two years many shops have, "robbed Peter to pay Paul" in order to keep machines running at a minimum of expense. Belting has been taken off equipment which is temporarily shut down and used on other drives where belts were needed. Then, when the orders are received to start production on the machines which were shut down the belts are frequently missing. This practice is quite common and cannot be condemned. But, on the other hand, the belt should be given more consideration for without it the machine cannot be operated.

Many shops undoubtedly have dozens of belts which have stood idle for some time. Before this belting is put back into service it should be carefully inspected and reconditioned if necessary. Belting often deteriorates more rapidly when idle than when in regular use. In addition, many things can happen to an idle belt and invariably the belt will need some attention to place it in first-class condition.

Here are a few conditions which should be checked: Is the belt saturated with oil or covered with dirt?; Are there any open laps?; Is the length correct?; examine fasteners for wear or breakage; check alinement of pulleys.

If belts have become soaked with mineral oil, degrease them by soaking in gasoline or carbon tetrachloride for 24 hours, or longer if necessary. In doing this it must be remembered that the degreasing not only re-

* Engineering Department, E. F. Houghton & Co., Philadelphia, Pa.

* * *

Delaware & Hudson Canal Company's shops at Scranton, Pa., in the early 1860's

moves all mineral oil but also the natural oil which is essential to lubricate the fibers of the leather. Therefore, after the belt has been thoroughly degreased dress it with a good belt lubricant to lubricate and preserve the fibers of the leather.

Do not use a sticky belt dressing as it will not lubricate the leather. Never permit foreign matter such as lumps of belt dressing, dirt, wood chips or adhesive material of any kind to gather on the belting or pulley faces. Clean the belt off by scraping with a dull edged scraper with rounded corners. Do not use a sharp scraper as the fibers of a belt must not be injured.

Check all the laps and see that they have not started to separate, especially the tip of the lap. If it is found necessary to re-cement a lap, be sure to scrape off all of the old cement. The laps should then be thoroughly roughened up, either with coarse emery cloth, a rasp or wire brush before the cement is applied.

A belt which has been left on an idle drive under tension has no doubt become permanently stretched. Therefore it is wise to remove the belt from the drive and shorten it to the proper length to give the desired tension on the drive. If the drive is to be idle for some time do not install the belt on the drive tight. It is better not to install the belt at all until it is needed.

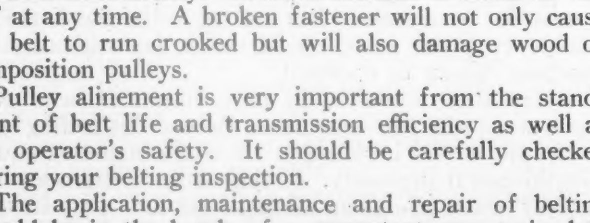
Fasteners of all types should be gone over carefully. If any of them are either worn or broken they should be replaced immediately. A worn fastener is liable to "let go" at any time. A broken fastener will not only cause the belt to run crooked but will also damage wood or composition pulleys.

Pulley alinement is very important from the standpoint of belt life and transmission efficiency as well as the operator's safety. It should be carefully checked during your belting inspection.

The application, maintenance and repair of belting should be in the hands of a competent man trained in this service. Many good belts have been ruined by incompetent repairs. If your plant does not have the facilities for properly reconditioning your belting, any reliable belt manufacturer can do this work for you. You will then receive the best job that good workmanship can produce and your machines will be ready when production starts.

Punch Used in Centering Lathe Work

A BELL-SHAPED bushing, as shown in the drawing, bored to fit a straight round centerpunch, will be found an aid in centering round stock for turning. If the end of the work is square, it may be centered with this punch to run more accurately than if centered on a



Bell-shaped bushing and center-punch for centering round stock

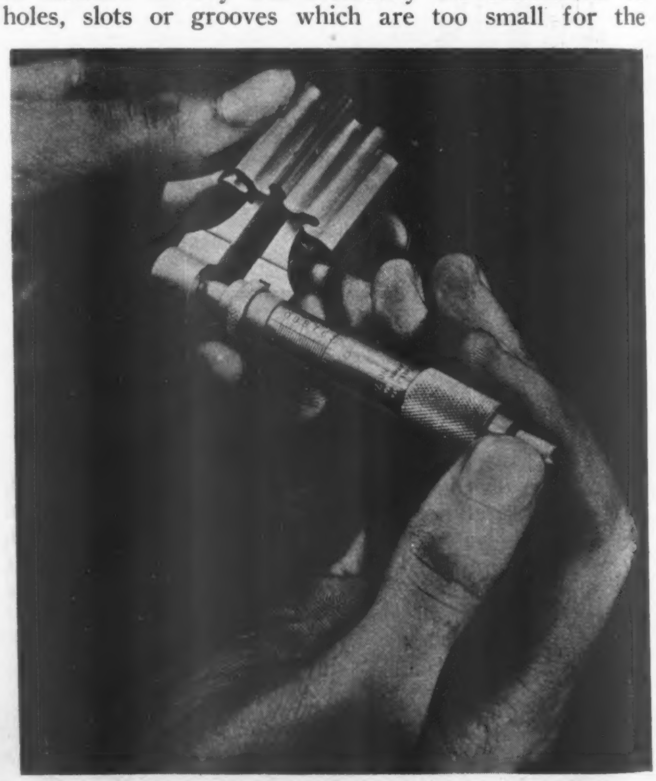
centering machine. Any center made with a hand punch is not as deep or well shaped as a drilled center and, on important work, the centers should be drilled and countersunk, after being located in this manner, which is more convenient than using hermaphrodite calipers to locate the center, especially on small work.

When a piece of work is on centers, it is difficult to face the end of it clear down to the center without leaving a tit. If one side of the tailstock center is ground off where the point of the facing tool comes, it will be found easy to face clear down to the center and even counterbore or recess the center so that the part will stand quite a bit of hammering on the end without knocking the center out of true. This is desirable on bolts, pins and piston rods, for the taper fit is tested by driving the parts in place.

Forgings for parts that are to be hardened after turning should be accurately centered, even though there is ample stock to "clean up," or they will warp in hardening. There is a difference in the texture of the metal of a forging near the surface that will cause an inaccurately centered piece to warp in hardening.

Inside Micrometer Caliper

THE L. S. Starrett Company, Athol, Mass., has recently placed on the market a new type of inside micrometer caliper known as No. 700 which is designed to measure directly and accurately the dimensions of holes, slots or grooves which are too small for the



Starrett No. 700 inside micrometer caliper being used to measure the bore of a small gear

regular inside micrometers.

All dimensions between .200 in. and 1 in. are within the range of this micrometer and can be measured easily in thousandths of an inch. As the illustration shows, this new micrometer combines the sliding jaws of a slide caliper and the easy-reading thimble and sleeve arrangement of a micrometer caliper. One jaw is fixed, the other is attached to the sleeve and opens or closes as the thimble is turned. Both jaws are cut away to facilitate measuring in close quarters.

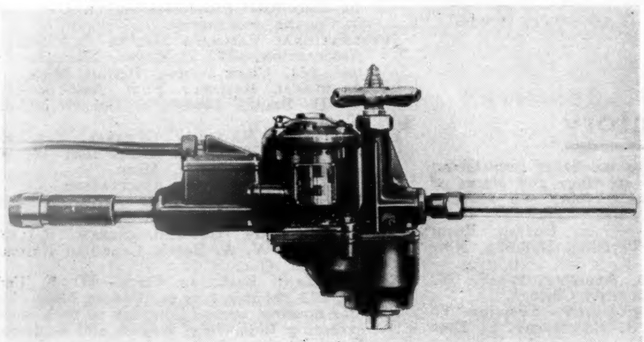
The position of the jaws can be fixed and the caliper

converted into a fixed gage by a twist of the lock nut. An additional convenient feature is the small knurled extension on the thimble which spins easily between the thumb and finger and speeds up opening or closing the jaws. While this new instrument is somewhat different in appearance from the convenient micrometer, it has the same sensitive "feel" and the same comfortable balance in the hand.

Electric Drill And Reamer

THE Independent Pneumatic Tool Company, 600 West Jackson boulevard, Chicago, has designed a type of drill and reamer, which is a departure from the usual straight design. As can be seen in the illustration the offset motor is separate from the frame and feed-screw post, which design makes a short machine and permits the use of a feed of greater range. This design also permits the use of a short spindle, which facilitates operating in close places.

Another feature is the switch handle, which is of the



Thor high frequency electric drill and reamer

safety roll type. This switch cannot be operated except by a turn of the operator's hand, and automatically closes when the hand is removed from the grip. The new Thor switch handle is similar in appearance to the throttle used on pneumatic drills. It has no exposed slots or openings to permit the entrance of dust or dirt through the handle.

This new drill and reamer is made in five sizes, having drilling capacities from 7/8 in. to 1 3/4 in.; reaming capacities from 11/16 in. to 1 1/8 in. and weighing from 33 to 55 lb.

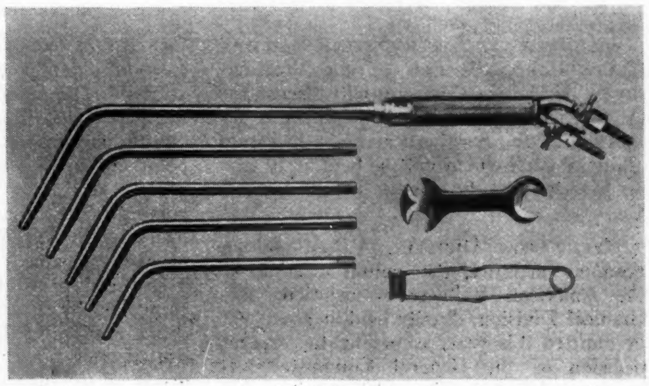
Welding Torch For Wide Range Of Work

THE Linde Air Products Company, 30 East Forty-second street, New York, has developed a welding torch known as the Purox No. 28. Ten one-piece, 60 deg. goose-neck tips, numbered from 6 to 15, are available for use with this torch. They are built of hard-drawn copper stock to withstand the intense reflected heat of the heavy welding jobs. By means of a union nut these tips may be adjusted so as to point in any direction. Thus, overhead or vertical welding can be accomplished without any change in the normal grip of the torch handle.

Tips Nos. 6, 8, 10, 12, and 14 are furnished with the torch, giving it a range from 16-gage sheet up to heavy castings. By using the Purox No. 21 cutting attachment with this torch, steel up to 2 in. in thickness can be cut.

The Purox No. 28B welding torch is the same as the Purox No. 28 welding torch except that it is supplied with tips Nos. 6, 8, and 10, mixer No. 6-10, friction lighter, and wrench.

By means of an adapter Purox No. 11 welding-torch

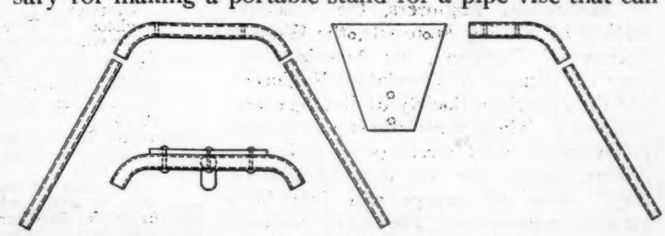


Purox No. 28 welding torch

tips can be used on both the Purox No. 28 and No. 28B torches. This provides a convenient means of increasing the range of usefulness of the Purox No. 28 welding torch in the lighter welding field. This feature is particularly useful in that it obviates investment in an additional small torch when there is only occasional need for light welding.

Portable Stand For Pipe Vise

IT IS often necessary for shop electricians to cut and thread conduit at out-of-way places or on the line of road. The accompanying drawing shows the parts necessary for making a portable stand for a pipe vise that can



Portable stand for electricians' pipe vise

be carried around and set up easily when it is necessary to do work away from the shop.

The few parts necessary can be made from material found around any railroad shop, the size of pipe for legs being selected according to the class of work to be done. Ordinarily, 3/4-in. pipe is heavy enough. The three pipe legs may be threaded or just a hand pressure fit in the larger bent pipe sections, which are secured to the 3/8-in. sheet-steel table plate by suitable rivets.

MAN OF MANY PARTS.—They say that while William H. Woodin, president of the American Car & Foundry Company, was participating in extended conferences with President-elect Roosevelt in Washington recently, violins and cellos of the Manhattan Symphony Orchestra were practicing his new score, "The Covered Wagon." Mr. Woodin's latest musical contribution was played in New York on January 29. Not content with being a leading industrialist and a director in many corporations, Mr. Woodin devotes such time as he can to music. His musical scores have won him a high place in the ranks of American composers.

Among the

Clubs and Associations

Southern and Southwestern Railway Club.—Robert Burgess of the Westinghouse Air Brake Company will discuss the A. B. Freight-Car Brake Equipment at the meeting of the Southern and Southwestern Railway Club which will be held at 10 a.m. on March 16 at the Ansley Hotel, Atlanta, Ga.

Mechanical Division, A.R.A.—As an economy measure, the annual meeting of the American Railway Association, Mechanical Division, usually held in June, will be omitted this year, according to a recent decision of the General Committee. It is expected that the General Committee will meet with all committee and sub-committee chairmen some day during the last week in June to consider mimeographed copies of the reports and take appropriate action regarding the submission of necessary details to letter ballot.

"Engineering Week."—One of the greatest and most important conferences of engineers ever held in this country, and probably the world, is expected to convene in Chicago during the week of June 25-30 in connection with the Century of Progress Exposition. This week is to be Engineering Week. Outstanding engineers of America and other countries have been invited to report the newest developments in their respective fields. Among the nineteen engineering associations co-operating in this program are the American Society of Mechanical Engineers, the American Society of Testing Materials, the Western Society of Engineers, the American Society of Heating & Ventilating Engineers, and the American Society of Refrigerating Engineers. These associations plan to hold individual or joint meetings of their own groups, except for one day, "Engineers' Day," when all groups will join in a gigantic conference. The sixth Midwest Engineering & Power Exposition will also be held during the week of June 25, instead of in February as formerly.

Club Papers

Locomotive Performance and Net Operating Income

Western Railway Club.—Meeting held Monday evening, January 16, at the Hotel Sherman, Chicago. Subject "The Relation of Locomotive Operation to Railroad Net Operating Income," presented by Thomas R. Cook, manager, inspection and field service, Baldwin Locomotive Works. ¶The comprehensive paper by Mr. Cook showed plainly that locomotive performance has a direct bearing on operating income of a magnitude which makes it one of the most important points of attack in the reduction of operating expense. The rapidly mounting cost of locomotive maintenance in the case of older power was clearly demonstrated. The objectives and conclusions of the paper were summarized in Mr. Cook's closing paragraph: "We have attempted to point out in this paper the possibilities of greatly decreasing the expenses which revolve around the use of locomotives. This decrease in expenses would become net operating income. When it is realized that over one-third of all operating expenses are controlled by locomotive use, these savings could gradually, through wider and wider use of new power, amount to some hundreds of millions of dollars annually. In no other phase of railroad operation is there anything like an equal opportunity to contribute to that rehabilitation of railroad earning power which is so sorely needed."

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—T. L. Burton, Room 5605 Grand Central Terminal Building, New York.

Allied Railway Supply Association.—F. W. Venton, Crane Company, Chicago.

American Railway Association.—Division V.—Mechanical.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

Division V.—Equipment Painting Section—V. R. Hawthorne, Chicago.

Division VI.—Purchases and Stores.—W. J. Farrell, 30 Vesey street, New York.

Division I.—Safety Section.—J. C. Caviston, 30 Vesey street, New York.

Division VIII.—Car Service Division.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

American Railway Tool Foremen's Association.—G. G. Macina, 11402 Calumet avenue, Chicago.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

Railroad Division.—Marion B. Richardson, associate editor, *Railway Mechanical Engineer,* 30 Church street.

Machine Shop Practice Division.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

Materials Handling Division.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

Oil and Gas Power Division.—Edgar J. Kates, 1350 Broadway, New York.

Fuels Division.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

American Society for Steel Treating.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

American Society for Testing Materials.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

American Welding Society.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

Association of Railway Electrical Engineers.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

Canadian Railway Club.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

Car Department Officers Association.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

Car Foremen's Association of Chicago.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, Auditorium Hotel, Chicago, Ill.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

Central Railway Club of Buffalo.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

Cleveland Railway Club.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium Hotel, East Sixth and St. Clair avenue, Cleveland.

Eastern Car Foremen's Association.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

International Railroad Master Blacksmith's Association.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

International Railway Fuel Association.—T. D. Smith, 1660 Old Colony building, Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha street, Winona, Minn.

Master Boilermaker's Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

National Safety Council—Steam Railroad Section.—W. A. Booth, Canadian National, Montreal, Que.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September, Hotel Statler, Boston.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

Pacific Railway Club.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

Railway Business Association.—P. H. Middleton (Treas. and Asst. Sec.), First National Bank building, Chicago.

Railway Car Men's Club of Peoria and Pekin.—C. L. Roberts, R. F. D. 5, Peoria, Ill.

Railway Club of Pittsburgh.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

Railway Fire Protection Association.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

Railway Supply Manufacturers' Association.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Supply Men's Association.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

Toronto Railway Club.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

Traveling Engineer's Association.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

Western Railway Club.—J. H. Nash, 1101 Peoples Gas building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

THE GRAND TRUNK has placed an order with the Timken Roller Bearing Company for the application of 40 axle roller bearings on 10 locomotives of the 4-8-4 type.

THE CHICAGO, BURLINGTON & QUINCY, on February 1, recalled 220 employees to work in its Aurora, Ill., shops, the return of this number after a brief layoff bringing the total force at work in these shops to 550 men.

THE MISSOURI PACIFIC has ordered air-conditioning equipment for 10 passenger cars as follows: For two Missouri Pacific and three Texas & Pacific lounge cars for use on the Sunshine Special, from the Carrier Engineering Corporation; for two International Great Northern lounge cars operating between Longview, Tex., and San Antonio, from the Westinghouse Electric & Manufacturing Company; and for three Missouri Pacific dining cars operating between St. Louis and Denver, Colo., from the Frigidaire Corporation. The equipment ordered from the Carrier Engineering Corporation is the Carrier-Vacuum type, while that ordered from the other companies is of the mechanical type.

Pullman Restaurant Cars Now on 19 Roads

THE EXTENT to which Pullman restaurant cars have supplanted dining car service operated by the railroads is shown in the fact that on January 1, 1933, the Pullman commissary department was operating 64 restaurant cars which served full meals on 29 lines, over 19 different railroads. In addition, it operates 171 buffet cars in the United States and 9 in Mexico, in which light repasts are obtainable; 137 composite cars, which may be partly sleeping cars or parlors with lounge and which may be equipped with a soda fountain and sandwich service or a broiler buffet; and 24 private cars which are subject to public demand.

About half the space on the Pullman restaurant cars consists of compartments or private rooms, or 6 to 10 sleeping sections and, in many cases, the latest parlor equipment. The remainder of the car is occupied by the restaurants and kitchens and a lounge. Provision is made for seating from 8 to 24 persons, varying according to the amount of business upon the different runs. The menus, although simplified, provide table d'hote and a la carte meals. The kitchens are modern in every way, finished throughout in monel metal, including the ranges, sanitary refrigerators and all other necessities and conveniences.

Pullman restaurant car

Electric Pipe-Welding Patents Upheld

AFTER LITIGATIONS extending over eight years in which the Johnston patents covering electric resistance welding of tubing and piping, owned by Steel & Tubes, Inc., Cleveland, Ohio, a subsidiary of the Republic Steel Company, Youngstown, Ohio, have been uniformly upheld, the United States Supreme Court has refused to review the decision handed down in the United States Court of Appeals in the most recent suit.

The litigation surrounding these patents dates back to 1924 when the first of four infringement suits was brought by Steel & Tubes, Inc., in the United States District Court of the Eastern District of New York. In this and the two succeeding suits the District Court held the patents valid and infringed. The third suit involved also the Belmont patent for rolling down the burr left by the welding operation which also was held valid and infringed. In this case the Johnston patents were held to cover edge-surface welding. In the first of these suits only was the decision appealed to the Circuit Court, and that court, the Circuit Court of Appeals for the second circuit, in New York City, sustained the original decision in May, 1925.

The fourth suit was brought against the General Tube Company, Newark, N. J., in the United States District Court for the District of New Jersey, which held the patents valid but declared them infringed only when machines were operated in excess of 30 ft. per min. Both parties appealed this decision to the United States Court of Appeals for the third circuit, and in October, 1932, this court handed down the opinion that the patents were valid and that the invention was not limited to any speed. The General Tube Company then filed a petition for a re-hearing, which was denied, and also filed with the United States Supreme Court a writ of certiorari, which was denied, bringing the long period of litigation to a close.

The process, originally developed by the Republic Steel Corporation to produce small, light-wall mechanical tubing, has been applied by that company to commercial production of pipe in sizes up to 16 in. in diameter and in all standard wall thicknesses. The electric resistance welding process, producing no zone of weakness at the weld, is believed to open the field of alloy steels and irons for piping material, as it is free from the limitations of the conventional fire-welding methods when handling materials of special analyses.

R. C. C. Loans

THE RAILROAD CREDIT CORPORATION, according to its monthly report to the Interstate Commerce Commission, on January 31, had either actually made or authorized loans to railroads to meet their fixed interest obligations totaling $53,259,918. Of that amount, $48,163,052 represented loans actually outstanding. Reported rate increases, under Ex Parte 103, totaled $57,159,070 in the first eleven months of 1932, and $4,957,977 in November.

Few Cars and Locomotives Installed in 1932

CLASS I RAILROADS installed fewer freight cars in service in 1932 than in any year since 1923, the first for which records were kept, according to reports filed with the Car Service Division of the American Railway Association. New freight cars totaled 2,968. In 1923, the number totaled 196,336 cars. Those put in use in 1932 include: Box cars, 1,092; coal cars, 661; refrigerator, 660; flat, 110; stock, 425, and miscellaneous cars, 20. The railroads in 1932 also installed 37 new locomotives compared with 124 in 1931 and 782 in 1930.

New freight cars on order on January 1, 1933, totaled 2,431 compared with 4,042 on January 1, 1932, and 9,821 on January 1, 1931. New locomotives on order on January 1, 1933, totaled three compared with 39 on January 1, 1932, and 120 on January 1, 1931.

Supply Trade Notes

THE NEW YORK AIR BRAKE COMPANY, New York, on February 15 opened an office in the Midland Bank Building, Cleveland, Ohio, with L. W. Sawyer and G. A. Allen as representatives at Cleveland.

THE DELAWARE STEEL SERVICE, INC., Philadelphia, Pa., has been appointed exclusive representative in the Philadelphia district for the Timken Steel & Tube Company, Canton, Ohio.

HOWARD A. HOLMES has entered the service of the Inland Steel Company in its sales department at Detroit, Mich. During the past year Mr. Holmes was assistant district sales manager of the Wierton Steel Company in Chicago, and prior to that time was in the sales office of this company at Detroit.

THE ASSETS of the Locomotive Terminal Improvement Company, Barrington, Ill., were sold at public auction on January 25. The patents owned and controlled were sold to a syndicate which has licensed the F. W. Miller Heating Co., and Frederick A. Gale, vice-president of the National Boiler Washing Company of Illinois, to continue the installation of locomotive boiler washing systems.

THE NEW JERSEY COURT OF ERRORS and Appeals, reversing a decree of Vice-Chancellor Bigelow, has set aside the appointment of receivers for the Pressed Steel Car Company. The opinion handed down on January 31 was written by Justice Joseph L. Bodine and held that the receivership was "not in the best interests of the public, the creditors and the stockholders."

ROBERT E. MOORE, vice-president of the Transportation Equipment Corporation, New York, has been elected president to succeed Thomas J. Crowley, resigned, and the office of the company has been moved from 230 Park avenue to 92 Liberty street, New York. This company has granted an exclusive license to Sperry Products, Inc., Brooklyn, N. Y., for the manufacture, sale and use of the Mackin automatic locomotive washer, formerly sold by the Transportation Equipment Corporation and now in use on many eastern railways.

STEARNS-STAFFORD, INC., Lawton, Mich., has been organized to take over the Stearns-Stafford division of George P. Nichols & Brother, Inc., and will continue the manufacture of staggered roller bearings at the plant in Lawton which has operated since 1921. O. F. Packer, who has been associated with the plant since the time of its origin, and who has operated the business as general manager since 1923, has been appointed president and general manager of the new concern. The remainder of the personnel at the plant remains the same. The new organization will concentrate manufacturing and sales activities on roller bearings for railway equipment, and heavy-duty bearings for industrial purposes.

MARION B. RICHARDSON, associate editor of the *Railway Mechanical Engineer*, has resigned to join C. Raymond Ahrens, 30 Church street, New York, in the railway and general sales business. The new firm will be a limited partnership under the name of Ahrens & Richardson, with offices at 30 Church street. Mr. Richardson was born at Girard, Pa., on March 2, 1892. He attended the public and high schools of Grove City, Pa., and in 1921 was graduated from the Pennsylvania State College with the degree of B.S. in railway mechanical engineering. He received the degree of M.E. in 1926. In 1912 he was employed as a machine hand by the Bessemer Gas Engine Company, Grove City, and in 1913 he entered the service of the Bessemer & Lake Erie, serving successively until 1915

M. B. Richardson

as track laborer, store-room laborer and locomotive fireman. From 1917 until 1919 he was with the A. E. F. as Second Lieutenant, Ordnance Department, assigned to the Aerial Armament Division of the Air Service as test engineer. He returned to the Bessemer & Lake Erie in 1919 as draftsman, mechanical engineering department, and in 1921 became shop draftsman. He became associate editor, mechanical department, of the Railway Age and associate editor of the *Railway Mechanical Engineer* in 1923. Mr. Richardson is secretary of the Railroad Division of the American Society of Mechanical Engineers.

Obituary

V. C. TURNER, vice-president and treasurer of the Scullin Steel Company, St. Louis, Mo., died on January 29.

CHARLES V. BARRINGTON, vice-president in charge of manufacturing, Jenkins Bros., Bridgeport, Conn., died on January 30 at his home in Bridgeport.

THEODORE G. SEIXAS, assistant to vice-president of the Allegheny Steel Company, with headquarters at Philadelphia, Pa., died at his home in that city on January 26 at the age of 59. Mr. Seixas at one time had served as general sales agent of the company and subsequently in charge of the New York and Philadelphia district; at the time of his death he was assistant to vice-president.

ISAAC H. MILLIKEN, a vice-president of the McConway & Torley Corporation, who died suddenly on December 30, in the office of that company at Pittsburgh, Pa., was born on August 30, 1872, at Pittsburgh. Mr. Milliken received his education in the public schools of that city and in August, 1888, entered the employ of the McConway

Isaac H. Milliken

& Torley Company as a clerk in the treasurer's office. About January, 1900, he became connected with the sales department and in 1925 was elected vice-president of that company remaining in that capacity until July, 1929, when the company became the McConway & Torley Corporation. Mr. Milliken was then elected one of the vice-presidents of the new corporation, in which position he remained until the time of his death.

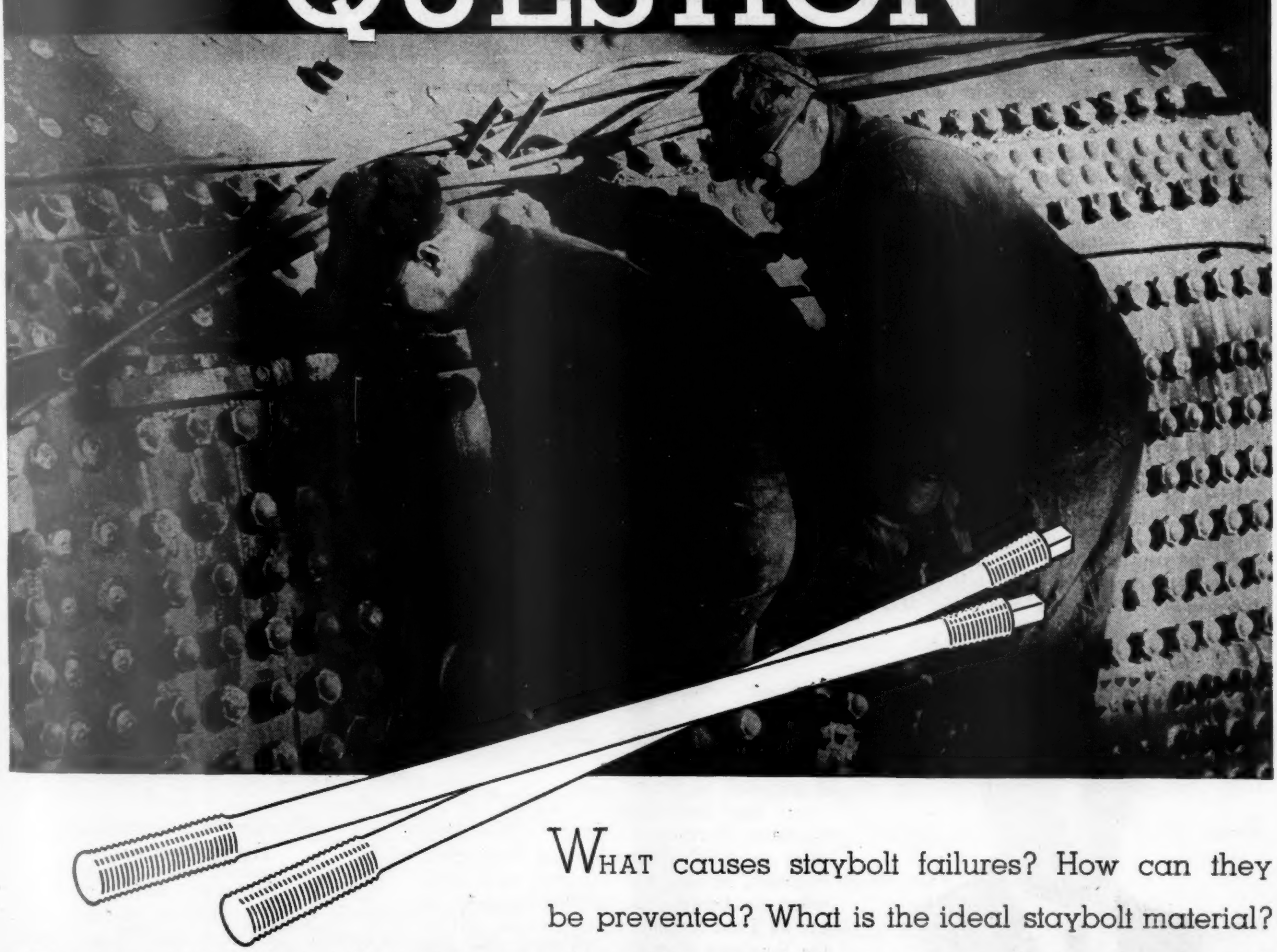
ALBERT C. MURPHY, representative of the Standard Railway Equipment Company, Chicago, and the Union Metal Products Company of Canada, Ltd., and presi-

Albert C. Murphy

dent of the Federal Railway Devices Company and the Canadian Appliance Company, died in Los Angeles, Cal., on January 25. Mr. Murphy was the son of Peter H. Murphy, founder of the P. H. Murphy

(*Continued on next left-hand page*)

THE STAYBOLT QUESTION



WHAT causes staybolt failures? How can they be prevented? What is the ideal staybolt material? « These questions have plagued railroad men for generations. « By research over a period of many years Republic metallurgists have thrown much light on the subject of staybolts. This information has been gathered into a booklet, "The Staybolt Question" and is available to anyone interested. « This study of staybolts and development of staybolt material has made Republic the preferred source of supply for longer-lifed staybolts. In Agathon, Climax or Toncan Iron, Republic can supply a staybolt particularly fitted to meet your own conditions.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Penna. has manufactured and is prepared to supply, under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION

REPUBLIC STEEL CORPORATION

MASSILLON, OHIO

TONCAN COPPER MOLYBDENUM IRON

Company, St. Louis, Mo., and a brother of Walter P. and Dwight Murphy. He was born in Bucyrus, Ohio, on June 25, 1877, and entered railway service as an apprentice in the shops of the St. Louis Southwestern at Pine Bluff, Ark., after which he took charge of the manufacturing plant of the P. H. Murphy Company, East St. Louis, Ill. Several years later he entered the sales department of the Standard Railway Equipment Company. He was also interested in several other enterprises, doing business in the United States and Canada, and was active in developing different freight car specialties.

WILLIAM BENNETT, for the past 30 years production engineer and chief inspector of the Union Steel Casting Company, Pittsburgh, Pa., died on February 3 of pneumonia after an illness of a few days. He was 75 years of age. Mr. Bennett had a wide acquaintanceship among the users of steel castings, particularly men of the mechanical and test departments of the railroads.

LEO M. DUNN, vice-president of the Graybar Electric Company, with headquarters at New York, died at his home in Garden City, Long Island, N. Y., on January 20. Mr. Dunn, who was born at Ispheming, Mich., on October 13, 1874, was, at the time of his death, completing 47 years of continuous service with the Bell System and the Graybar Electric Company. He began his business career in March,

Leo M. Dunn

1886, as an office boy with the Central District Printing & Telegraph Company of Pittsburgh. In 1910, after 24 years of service in the operating department of the telephone business, Mr. Dunn became connected with the Western Electric Company as chief storekeeper, at Pittsburgh, Pa. In 1913, he was made manager at Pittsburgh, and in 1918, was transferred in this capacity to Philadelphia, Pa. Later in 1918 he was appointed assistant eastern district manager, and in 1921 was transferred as manager to New York City. Later in 1921 he became eastern district manager, and in 1923 was appointed general merchandise manager of the entire supply department of the Western Electric Company. When the Graybar Electric Company was formed in 1926, Mr. Dunn was made a vice-president.

Personal Mention

General

FRANCIS G. LISTER, assistant superintendent of motive power of the St. Louis-San Francisco, has been promoted to superintendent of motive power, with headquarters as before at Springfield, Mo. Mr. Lister has a record of many years' experience in the mechanical departments of various western railroads. He was born on July 8, 1882, at Marysville, Kan., and studied for two years at the University of Nebraska. His first railway service was with the Wabash in 1901, as a special apprentice, becoming a mechanical draftsman a short time later. In 1906, Mr. Lister went with the Northern Pacific as a

Francis G. Lister

locomotive and car draftsman, and five years later he entered the employ of the Spokane, Portland & Seattle and affiliated lines as chief draftsman and mechanical engineer, serving this company until 1916, when he became mechanical engineer of the El Paso & Southwestern (now part of the Southern Pacific). In 1924, Mr. Lister was appointed master car repairer on the Southern Pacific, at El Paso, Tex., and in 1926 he became chief mechanical engineer of the St. Louis-San Francisco, and on January 1, 1931, was appointed assistant superintendent of motive power.

E. W. SMITH, who has resigned as co-receiver of the Seaboard Air Line to return to the Pennsylvania as vice-president in charge of consolidation work and other duties directly under W. W. Atterbury, president, was born in Clarksburg, W. Va., on September 21, 1885, and received his education at the Virginia Polytechnic Institute, from which he was graduated in 1905. In June of that year he entered railway service with the Pennsylvania, serving in various positions in the motive power department. In October, 1913, he was appointed assistant master mechanic at Wilmington, Del., and was transferred in the same capacity to Altoona, Pa., in April, 1915. The following year he became assistant engineer of motive power. He was transferred to Harrisburg, Pa., on October 10, 1917, as master mechanic, and on May 26, 1918 to Williamsport, Pa., as superintendent of motive power. He returned to Altoona as superintendent of motive power in December, 1919, and the following year was promoted to engineer of transportation on the staff of the vice-president in charge of operation at Philadelphia. Mr. Smith was appointed general superintendent of motive power at St. Louis, Mo., on October 15, 1922; two

E. W. Smith

years later he was promoted to general superintendent of the Western Pennsylvania division, and in September, 1926, he was appointed general manager of the Eastern region. In September, 1928, he was appointed regional vice-president of the Pennsylvania, leaving that company in December, 1930, to accept an appointment as co-receiver of the Seaboard Air Line.

Master Mechanics and Road Foremen

W. H. DUXBURY, acting master mechanic of the Halifax division of the Canadian National, has been appointed master mechanic with headquarters at Halifax, N. S.

G. B. PAULEY, assistant master mechanic on the Chicago, Burlington & Quincy, with headquarters at Sterling, Colo., has been transferred to the position of assistant master mechanic, Sheridan, Wyo. The position of assistant master mechanic at Sterling has been abolished.

Car Department

EMIL LEONHART has been appointed car department foreman of the Chesapeake & Ohio at Walbridge, Ohio.

A. F. ZIEBOLD has been appointed general car foreman of the Chesapeake & Ohio, with headquarters at Columbus, Ohio.

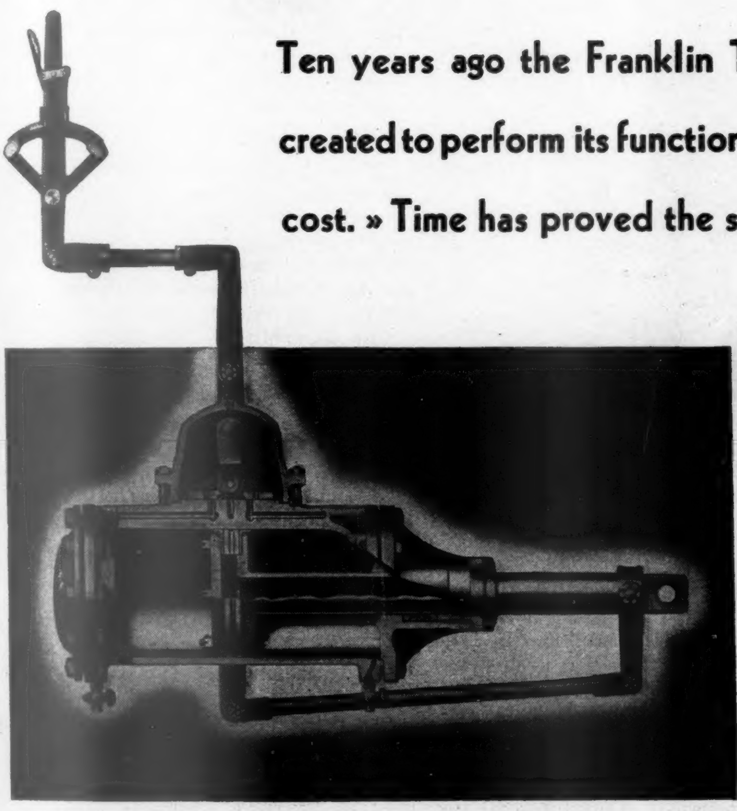
C. F. EHRMAN, general car foreman of the Chesapeake & Ohio at Columbus, Ohio, has been appointed general foreman, with headquarters at Russell, Ky.

OSCAR FRANK WEIK, general car foreman of the Chesapeake & Ohio at Russell,

(*Continued on next left-hand page*)

USE A GEAR that time has tested

Ten years ago the Franklin Type "E" Power Reverse Gear was created to perform its function with a minimum of parts and at lowest cost. » Time has proved the soundness and economy of the design.



FRANKLIN TYPE "E"
POWER REVERSE GEAR

DESIGN DETAILS

A balanced slide valve is used. Every air man is familiar with this type and understands the little maintenance required.

Crossheads and guides are eliminated, thus reducing weight, number of parts for stock and over-all dimensions.

The piston trunk and front head are proportioned to care for all side and vertical stresses at low unit bearing pressures. The self-adjusting piston rod packing requires no attention between shoppings.

The seal between the Rocker Arm and the Valve Chest is accomplished by a metallic joint. This is an advantage over soft packing.

Specify Franklin Type "E"—the time-tested Power Reverse Gear that has proved its economy on thousands of locomotives.

FRANKLIN RAILWAY SUPPLY CO., INC.

NEW YORK CHICAGO MONTREAL

Ky., has been appointed superintendent of the car shops at Russell, succeeding C. V. Ratcliff, deceased. Mr. Weik was born on October 9, 1891, at Ironton, Ohio. He attended school at Ironton and on August 4, 1909, entered the employ of the Chesapeake & Ohio as a laborer. He became a

O. F. Weik

car repairer on November 2, 1909; gang foreman, October 10, 1914, and general car inspector, Ashland division, September 15, 1925, his territory later being extended to include the Huntington and Hinton divisions. Mr. Weik was appointed general car foreman on October 11, 1929, at the time the new car shops at Russell were put into operation. He was promoted to the position of shop superintendent on December 1, 1932.

James Hall, master car repairer at the general shops of the Southern Pacific at Sacramento, Cal., retired on February 28, after 46 years' service with this company. Mr. Hall was born in London, England, on February 21, 1863, and first entered railway service on February 1, 1876, as an apprentice in the car shops of the Sheffield & Lincolnshire Railroad at Manchester, England. In 1886, he migrated to the United States and on May 12 of the following year entered the service of the Southern Pacific at Oakland, Cal. In August, 1899, he became a passenger car builder in the general shops at Sacramento, being appointed gang foreman of the platform department on March 1, 1900. On March 1, 1904, Mr. Hall was appointed assistant general foreman of the car department of the general shops and on August 6, 1912, he was promoted to the position of master car repairer of the Coast division. On March 15, 1917, he was transferred to the general shops at Sacramento, where he served continuously until his retirement.

Shop and Enginehouse

E. C. Mosher, assistant foreman of the Canadian National at Truro, N. S., has been appointed locomotive foreman, with headquarters at Truro.

E. R. Battley has been appointed superintendent of shop methods of the Canadian National, with headquarters at Montreal, Que. Mr. Battley will have jurisdiction over the entire system.

Purchasing and Stores

Harrison M. Rainie has been appointed purchasing agent of the Boston & Maine, with headquarters at Boston, Mass.

U. K. Hall, general storekeeper of the Union Pacific System, has been promoted to general purchasing agent in charge of purchases and stores, with headquarters as before at Omaha, Neb. In this appointment Mr. Hall succeeds to a position that has been vacant since the death of G. W. Bichlmeir on October 23, 1932. Mr. Hall, who was born on September 12, 1878, at Portland, Ore., entered railway service in 1897 with the Union Pacific System, and has advanced through various positions in the purchasing, accounting, operating, engineering and stores departments. He was appointed general storekeeper of the

U. K. Hall

Oregon-Washington Railroad & Navigation Co. (a unit of the Union Pacific System) at Portland, Ore., in 1913. In 1916 he was sent to Omaha as general storekeeper of the Union Pacific Railroad. During the World War Mr. Hall was stationed at Washington, D. C., as assistant to the manager of stores of the United States Railroad Administration. Following the war he was appointed general supervisor of stores of the Union Pacific System, and in April, 1932, was appointed to the newly-created position of general storekeeper of the system.

Obituary

C. A. Barnes, general foreman of the Belt Railway of Chicago, died, at Indianapolis, Ind., on December 26, 1932, following an illness of four months.

C. V. Ratcliff, shop superintendent of the Chesapeake & Ohio at Russell, Ky., died on November 9 at the age of 50 years. Mr. Ratcliff entered the employ of of the C. & O. on October 5, 1905, as a car repairer at Huntington, W. Va. He subsequently held the positions of mechanical draftsman at Richmond, Va.; general car inspector, Western General division, and general car foreman at Huntington. He was appointed superintendent of the car shops at Russell on September 16, 1929.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

Freight Brake.—The new Westinghouse Type AB Freight brake equipment is described and illustrated in Publication 9079 issued by the Westinghouse Air Brake Company, Pittsburgh, Pa.

"The G-R Storage Tank Oil Heater."—This is the title of the bulletin, Form 484, issued by the Griscom-Russell Company, 285 Madison avenue, New York, describing its storage tank oil heater for heating viscous oil to be withdrawn from field tanks, tanks on shipboard, and other types of oil-storage tanks.

"The Staybolt Question."—The Republic Steel Corporation, Massillon, Ohio, presents in this 20-page booklet a summary report of many years of staybolt manufacture, with accompanying laboratory and service tests. It is for the officer responsible for the design, care and maintenance of the locomotive.

Sanders, Valves and Repair Parts.—The Viloco Railway Equipment Company, Chicago, combines in its catalog No. 32 all of the traps, valves, and repair parts, both of the old and new designs most commonly used, in order to assist purchasing agents, storekeepers and repairmen to readily identify the various parts so that proper maintenance and repair can be made.

Freight-Car Brake Equipment.—The New York Air Brake Company, 420 Lexington avenue, New York, has issued Instruction Pamphlet No. 5030-1 covering the KD-4-12 freight-car brake equipment. Instruction Leaflet No. 2356-1 gives instructions on the use of condemning gages for No. 6-E and No. 6 Distributing Valves. Circular Notice No. 1101 describes a brake cylinder piston rod sleeve protector.

Lukens Iron-Clad Steel.—New and interesting applications of Lukens Nickel-Clad Steel in chemical and industrial processing equipment, in transportation, in the textile industry and in general industrial service are shown in an eight-page bulletin issued by the Lukens Steel Company, Coatesville, Pa. Lukens-Nickel-Clad Steel is a hot-rolled bi-metal composed of a light layer of dense, homogenous nickel bonded to a heavy layer of steel.

Garlock Packings—A 158-page, cloth-bound catalog, in the printing and illustrations for which several soft-tone colors have been used, has been issued by the Garlock Company, Palmyra, N. Y. This catalog illustrates and describes those styles and types of Garlock materials for which there is general usage and demand, and is intended to serve as a complete guide and reference book for mechanical packing materials.